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AUTOMOBILE STANDARDIZATION.

There is no doubt that in a young and new art, standardization may be pushed too vigorously and too far, but it is evident that in many branches of electricity the time has arrived when uniformity should be arrived at and can be attained. Telegraph apparatus is fairly well standardized and even telephony with all the heterogeneity introduced into it by the growth of the independent movement tends irresistibly towards standard types and methods. The work that has been done and is still under way in lighting, power and traction, is too familiar to need recapitulation, and standards in those fields meet us in every direction, while no one can complain of any curtailment of freedom. It is better for all that there should be a 110 voltage than 110 different voltages.

In the electric automobile field, the tendency even thus early is happily making itself manifest. One might almost say that 44 cells of storage battery, with all that follows, had already become firmly settled as the standard and unit. But when it comes to charging, or to change of batteries, it is obviously necessary that battery boxes should be standardized, that charging plugs should be "universal" and that every charging plant or plant available for charging should be equally useful and accessible to every vehicle that comes along and needs "juice."

ELECTRICAL EXHIBITS AND EXHIBITIONS.

It seems likely that the Chicago Fair of 1893 will be the last of the exhibitions of the old type, biggest and best—and worst. The original idea of an exhibition was to show anything and everything, and if the anything happened to be a primary battery or a push button, to make a pyramid of large quantities of it, or some fantastic design. Just what instruction there was in that, it would be hard to say, but the method prevails even now in minor shows, and dies hard. That it is dying, however, is certain. At the great Paris Exposition which is now close upon us, there will probably be some of the old baronial castles made out of pickle pots, but the authorities there have been making a most laudable effort to restrict the exhibits to that which is selected, instructive, strictly novel, and fairly sequential in its motive as an appeal to public intelligence. After all, this aim at limitation is only what is done at an annual picture exhibition of any importance. Vastly more pictures are rejected than are accepted, and with good reason.

The occasion of these remarks is a special despatch from Paris to the effect that the United States will come next to France at the Paris Exposition in number of exhibitors, with 7000 of them, but that many American products would be barred for inferiority. This is denied, although it is straining even American ability to put forward 7000 distinct exhibits of merit and novelty. We are glad to be in a position to say that the electrical and mechanical exhibit from this country will be very fine, but as a matter of fact American manufacturers will not exhibit electrical apparatus in any great bulk or profusion. The stress will be laid on pioneer work, historical apparatus and such novelties as may properly bring them to the notice of the visitors of the Exposition. This absence of the voluminous exhibits of previous shows arises from the fact that the manufacturers have been exhibiting year after year in this country and abroad at

enormous expense. The rivalry during the promotion period of the various organizations developed copious displays in the crude nature of warehousing material. Those companies that could make their exhibits very extensive were enabled to impress the public with their importance and were thus aided in promotion. This, however, is changed. Promotion in manufacturing enterprises of this kind is largely freed from stock jobbing operations and they have got down to a dividend paying basis, where economy is practiced. The electric art has developed such a variety of apparatus and devices, that in the case of one concern alone, there being over 12,000 articles made by them, it becomes not alone expensive but an impossibly burdensome task to make a display of all their resources. Yet there are at least 1000 other electrical manufacturers in the United States.

There is so much electrical apparatus in actual operation to-day in railway, light and power plants, telegraph offices and telephone exchanges, that unless the exhibit is a new departure, it interests neither the public nor the engineer. The engineer prefers to see apparatus operated under the conditions it is to serve rather than simply set up for idle, silent demonstration. The public from whom gate receipts are derived, prefers to see that which is absolutely new, novel and interesting. This point applies to the Pan-American Exposition next year. It is a matter of common knowledge that Buffalo and Niagara to-day, without the Pan-American, have about the finest collection of modern electrical apparatus and inventions in use that the world can show, open to any engineer who wants to see it running; and absolutely unintelligible to the public that hardly knows the rudiments of the art. Why should such an exhibit be duplicated, or how could it be, for gate money?

It seems to us therefore that to secure at Buffalo an electrical exhibit that is feasible and will not burden the busy manufacturer, a desirable new departure would suggest itself, and that is to enlist the resolve of each manufacturer to contribute only such articles as might be considered really novel or of historical and retrospective interest, thus making rather a collective exhibit than individual space exhibits. When one considers the number of firms in the United States, each of which would only contribute one or more worthy exhibits, the number of these would be very large, and would prove to be very interesting to the engineer and certainly deeply instructive to the general public. Had it not been for the rivalry at the Chicago Columbian Exposition of 1893 between three of the large electrical manufacturing companies, each of which went to enormous expense in practically filling between them the whole ground floor of Electricity Building, the exhibits in that section would have been very limited; especially as so much electrical apparatus was in actual service and had to be placed in Machinery Hall. Later exhibitions in this country, even under most favorable circumstances, have shown the difficulty of getting together large quantities of electrical displays, and in a general way all have failed in that respect. Even at Paris, owing to the admirable intention to show raw material, processes and product together, by means of electric motors, the electrical exhibit to that extent will suffer seriously. On the other hand, the useful effect in proving the beauties and advantages of electric power distribution will be greater than has ever been secured before on these lines; and after all that is the true way to get at the result, the education of the public in the larger use of what we have to sell, for their benefit not less than our own.

ELECTRICITY IN FRANCE.

That France is the most backward of the leading countries of Europe in the utilization of electricity is, we believe, a fact. That reasons exist for this condition which relieve France of any reproach based upon non-progressiveness can, we also believe, be taken for granted. What some of these reasons are becomes apparent from a report in one of our Parisian contemporaries of two recent legal contests, which illustrate the onerous conditions imposed upon those who are freely willing to take the risk of investing their money in the commercial exploitation of electricity.

Some years ago a number of French towns and cities that had accorded franchises for electric lighting were prosecuted by gas companies for injuring their vested rights, and were obliged either to withdraw the franchises granted or to pay heavy damages to the gas companies. A sequel to one of these suits is a recent decision requiring a gas company to pay, in turn, a large sum of money to the creditors of an electric company which, seven or eight years before, it had ruined in the above manner—the refusal of the gas company to introduce itself the electric light being the grounds of the award. It is most sincerely to be hoped that other French gas companies will have to pay a similar penalty for retarding progress.

Another case reported is that of a city which had its right to award an electric light franchise contested by a gas company. After lengthy argument it was decided to submit the matter to arbitration, the city appointing one expert, the gas company another and the prefect of the department a third. The two latter members reported against the city, and assessed against it the costs of the arbitration, which the mayor now refuses to pay in their entirety, though willing to compensate the city expert. The question naturally occurs, What percentage of its present 3000 central stations would the United States possess if both those wishing to invest their money in the electric lighting industry, and the towns and cities desiring to grant franchises for electric lighting, had been deterred by such penalties as the French gas companies appear to have it in their power to impose?

THE CONCENTRATION OF PHILADELPHIA LIGHTING STATIONS.

As is the case in many of the other large cities in this country, the consolidated central stations' interests in Philadelphia have found it necessary to substitute for the many small stations established by the separate companies previous to the consolidation, one, or a few large central generating plants with one uniform system of transmitting and distributing power to local sub-centres. Following the lead which has been set by the Brooklyn Edison and the Chicago Edison companies, the polyphase high-tension generation and inter-station transmission has been adopted, with rotary converters for feeding the Edison system from the high-tension lines, and with other types of regenerating machinery for supplying its local distribution system of other styles. Its high-tension arrangements differ radically from those of the other companies above-mentioned in that the frequency of the polyphase power is 60 instead of 25 cycles per second.

This gives immediately an advantage in that all 2000-volt 60-cycle house-to-house distribution can be supplied from the high-tension lines with the interposition of transformers only, while with 25-cycle generation, frequency changers, such as those used in Brooklyn, are necessary. The comparatively high frequency, however, introduces difficulties in the construction and operation of the rotary converters which necessarily have more crowded poles, a higher peripheral speed and a smaller number of slots per pole. The art of rotary converter construction has so advanced in the last few years that while this difficulty, combined with increased self-induction and other disadvantages of the higher frequency, was rightly considered in the case of Brooklyn to warrant the used of a lower frequency in spite of the necessity of frequency changers for all 60-cycle circuits, at the present date the simpler system of generating at 60-cycles

initially is undoubtedly preferable unless the amount of rotary converter work greatly outweighs the amount of 60-cycle distribution.

The Philadelphia system differs from those already operating or proposed in many other large cities in that more than one permanent generating station will be maintained, the separate generating plants being connected with each other by tie lines of sufficient capacity so that one can lift a considerable portion of the load of another, thus allowing the most convenient and economical division of the whole load at all times.

REFORMS IN ELECTRICAL UNITS.

We print in this number an article by Prof. Fessenden, and an abstract of a serial article recently appearing in our esteemed contemporary, the London *Electrician*, from the pen of Dr. Fleming. Prof. Fessenden clearly points out that it would be very desirable to have electrical units rationalized, in order to suppress the irrepressible 4π ailment with which they are at present afflicted. Heaviside has long and strenuously advocated the most direct means of doing this. Unfortunately his plan involves so radical a change in existing standards, apparatus, agreements and literature as to appal even the least conservative electricians.

It is now well known that an error of judgment was made in the otherwise excellent work of the British Association for the Advancement of Science in establishing the C. G. S. electromagnetic system of units. The fundamental entities were magnetic poles and electric charges. We now understand that the fundamental entities are magnetic and electric fluxes. It is an incident that at the surface of a magnet at which flux enters or emerges, there is a pole. It is likewise an incident that at the surface at which electric flux enters or emerges, there is a charge. Instead of so choosing the basic units that a unit pole was acted on with unit force in unit magnetic flux density, and that a unit charge was acted upon with unit force in unit electric flux density, they should have been so chosen that a unit flux emanation at a pole or at a charge was acted upon with unit force in unit flux density. This would have meant that the pole strength and charge we now call unity would each become $1/\sqrt{4\pi}$; or in other words, our present unit poles and charges are roughly three times too small. If this oversight had not occurred, our C. G. S. system would have been as nearly perfect as human ingenuity could make it, and the 4π eruption would never have marred the beauty of its countenance.

Theoretically, of course, we ought to confess the original sin and do penance by uniting upon an international agreement that after a certain date our fundamental unit magnetic poles and charges would be increased about threefold, our units of e. m. f. threefold, and of resistance and inductances a dozenfold; while our units of current would be diminished about threefold and our unit of capacity a dozenfold. These ratios, of course, are mere approximations, and the exact ratios would be all some function of π, and would be like π, incommensurable. Just as in a certain sense therefore we do not know a circle's circumference *exactly* when given its diameter; so in a certain sense we might say that we would not know *exactly* how our ammeters, voltmeters, etc., should be recalibrated; while the approximate ratios would be as awkward as any found in the present system of English weights and measures. The only units which would come unscathed and unaltered out of the chaos of reorganization would be the units of energy and power, for the reason that these in a certain sense are not electrical at all. We do not believe that there are many electricians who have sufficient courage to demand so radical a change in the C. G. S. system, and, of necessity, in the volt-ohm-ampere system.

Not only do we labor under a C. G. S. system with 4π excrescences, but we also labor under a wholly unnecessary burden in the practical system, or quadrant-eleventhet gramme-second system. We first teach students the chaste and simple beauties of the fundamental centimeter-gramme-second system (with or without 4πs), as applied to electrical matters, and then make him learn to apply a distant relation in which the unit of length bears the ratio 10^9, and the unit of mass 10^{-11}. What should have been done would have been to give names to the C. G. S. units and appropriate prefixes or suffixes to distinguish their submultiples. The terms farad and microfarad are jointly shining examples of what might have been done in this direction for all the electric and magnetic units. It is not too late, and it is now indeed time, to rectify the last named error by christening the C. G. S. units and establishing simple connecting links in terminology between them and their "practical" prototypes. We think it is too late to revise the C. G. S. units and rationalize them for the expulsion of the unnecessary pi-s.

Prof. Fessenden here comes to the rescue and suggests an intermediate solution of the difficulty. He points out that without altering any fundamental units in the C. G. S. or practical systems, we may rationalize the formulæ, as distinguished from rationalizing the units, by agreeing that the permeability of either ether or air (it is of not much practical importance which) shall be numerically either 4π or its square, according to the manner of defining it. In that case, seeing that the value of the permeability enters into all the units in the magnetic system, we introduce automatically the right factor to rationalize the system of formulæ and clear it of superfluous 4π's. The current-turns, for instance, would then immediately become the magnetomotive force, and so on. Since no one knows what the absolute value of the permeability of ether may be, and we only agree at present to call it unity, no one will be hurt if we change our minds and say it is a dozen times as much. To pay for the rationalization we have only to alter the numerical values of tabulated or measured permeabilities in iron and steel. We think that the Fessenden suggestion is feasible and would distinctly simplify the ordinary formulæ and textbooks on electromagnetics. It is, of course, inferior to a rationalization of the units, but is probably the only practical alternative. We hope that it will receive the consideration of the coming Electrical Congress at Paris, since the change would have to be universal to be of any real advantage.

Dr. Fleming desires to do more than rationalize formulæ by the aid of altering the conventional permeability of ether. He wants to change the practical system of units to one in which the ratio to the parent units in the C. G. S. system would either be unity, or ten to a positive or negative eighth power. Such a practical system would no doubt be better and simpler than the present. It would mean changing the existing quadrant-eleventhet gramme-second system into the tenth quadrant-eighthet gramme-second system, or a system whose unit of length was 10^8 centimeters, and unit of mass 10^{-8} grammes. But we are opposed to the substitution of taskmasters. Give us the C. G. S. system itself and not another distant relation to it. What we want are proper prefixes, not another system of units.

We think that it is very important to ask the Paris Electrical Congress for such an authorized terminology as shall connect our present practical units with their fundamental congeners in the C. G. S. system, so that when one speaks of the present ohm it shall be apparent to the mind without effort, that this is 10^9 C. G. S. units, just as the microfarad makes it apparent to the mind that it is 10^{-8} farad that is discussed. We also hope that Prof. Fessenden's proposal to rationalize electromagnetic formulæ may also be considered, as a separate and independent proposition.

Telegraph and Telephone Work in the Philippines.

American engineers and electricians will be interested in the application of electricity to military purposes which has been carried out on a scale unprecedented in warfare by the United States Signal Corps. This work, as well as that done in Cuba and Puerto Rico, has attracted attention of electricians in all civilized countries. Indeed, it is within the past month, as noted in these pages, that the *Telegraph Chronicle*, the organ of the British telegraphers, made a strong appeal to its own men, and described in glowing terms the gallantry of American telegraphers during the Spanish-American war. The superintendent of the British Telegraphs says: "It is our men's ambition to do as good work as the American telegraphers did for their country—they have given us our ideal, and we will try and work up to it." This is an unprecedented compliment to the courage, ability and efficiency of the American Signal Corps.

General A. W. Greely, in his annual report, points out that the operations of the Signal Corps have been coincident with every military operation in the Philippines. Under Major Richard E. Thompson, backed by the high moral standing and professional knowledge of the enlisted operators, they repaired the English cable in Manila Bay and assisted in restoring the Eastern Extension cable around the Viscayan Islands. A Signal Corps cable laid from Manila to Cavite furnished for months the only means of communication. The local telegraph and telephone system included not only corps, brigade and division headquarters, but was extended to every regiment in the command. When the insurrection broke out every telegraph line to the northward was cut in Manila by the insurgents at 10 o'clock at night, but by daybreak every line was repaired and in operation. No expedition entered the field without a Signal Corps detachment, and no commanding officer of such an expedition ever pitched his tent without a telegraph or telephone office at his side, a single exception being Lawton's flying column when that indefatigable soldier and resourceful officer found even his wonderful energy almost unequal to a wild tropical country impassable by typhoon rains.

During the civil war it was occasionally asked if any one had ever seen a dead signalman, but the men of the Signal Corps in the Philippines have operated under different conditions, establishing and operating offices on the firing line. The signalmen have been present and under fire in no less than 61 skirmishes or engagements, and the percentage of dead, wounded and prisoners is as great in the Signal Corps as in any other organization in the Philippines.

It was admitted that the record of 260,000 military messages transmitted in the ten months ending June 30, 1899, on the Island of Luzon broke the record for military telegraphy; but it has since appeared, however, that telegraphic work had only commenced, and from 700 messages a day the average has rapidly risen since July last, and in September aggregated for the month 74,000; and in October the number rose to 3000 daily, and remained nearly stationary at 4000 daily during November and December. An extension of field operations during January has, however, brought on a great increase, and during the month of January the average has exceeded 5000 messages each day.

The field outfit of the Signal Corps is a novelty in telegraphy. The signalman carries a box of about nine cubic inches, the invention of Colonel James Allen and other officers of the Signal Corps. It affords communication either by telegraph or telephone through the instrumentality of a so-called "buzzer." This "buzzer" is a vibrator operated by a high tension current generated from a dry battery and an induction coil carried in the box. The wire used is No. 22 copper carried on a portable reel when used in connection with outposts. A seven-ply wire of two gauges consisting of six steel wires is wound around a copper wire of the same diameter. This makes an extremely flexible yet strong wire of great conductivity. Large quantities of the seven-ply wire insulated by almost pure para rubber are used in active military operations, while in commercial operations naked wire is used which is placed on lances and secured by rubber insulators. When military operations are rapid, insulated wire is used by one detachment who keep up with the advancing columns, and this insulated wire is replaced by a second detachment following, by naked wire.

The "buzzer" has been a most valuable adjunct for communication. It operates through connecting wires miles in extent whether through swamp or lying on the ground. On one occasion it made available for a week a copper circuit 30 miles long laid upon the ground without any insulation whatever. Similarly it has worked the Singal Corps' cables at times when mechanical injuries to the cable had caused serious leaks.

The adaptability of the Signal Corps man has been shown on many occasions where unusual methods of communication were speedily improvised. A striking case is instanced of an occasion at the capture of La Loma, where communication between the Pennsylvanians and South Dakotas and the Brigade Commander was most essential for co-operative movement. It chanced that there was a wire fence a mile or more in length, one wire of which was connected by Captain Edgar Russel at both ends with the signal wire, and by means of the "buzzer" the Signal Corps operators worked over the entire line, including the fence line.

The Signal Corps office at Manila is first-class in all its equipment. It has a hundred-wire switchboard, a dynamo and storage battery system for furnishing line current, and other up-to-date apparatus. All messages are taken on the typewriter. In this office centre daily all reports from every military command on the Island of Luzon.

Despite the vast volume of business done, everything goes on systematically, regularly and promptly as if in the United States. Owing to the lack of mails and post-roads, business of all character is necessarily carried on by wire whether it pertains to food, forage, animals, orders or other business. The volume of work done is so great that often only the more urgent military messages can be handled. There are over 100 Signal Corps telegraph offices in operation on the Island of Luzon alone. The telegraph system is supplemented by telephones which replace the key and sounder on all short lines. Nearly 200 long distance Bell telephones are operated by the Signal Corps in Manila, and its immediate vicinity, this being the only way in which public business can be promptly done.

Patents and the Department of Commerce.

A rearrangement of some of the governmental services is in contemplation, and on Feb. 8 Senator Nelson was authorized by the United States Senate Committee on Commerce to report his substitute for the bill providing for a Department of Commerce and for a new cabinet officer. The Patent Office has been added to the bureaus coming under the new department. All matters relating to transportation, the mining industries, manufacturing, the life-saving service, the steamboat inspection service, Bureau of Navigation and the Department of Labor are to be brought under the new department. The Treasury Bureau of Statistics and the Bureau of Foreign Commerce of the State Department are to be consolidated into a single bureau of the new department. Consular officers are directed to make commercial reports to the head of the new department and to receive instructions from him in regard to commercial inquiries. It has been the aim of Senator Nelson to economize expenditures as far as possible by consolidating some existing offices and transferring others with their existing salaries to the new department.

The principal new offices created are the secretary and assistant secretary of commerce and industries, the secretary receiving a salary of $8000 and the assistant secretary $4000. Senator Nelson has already prepared a careful report reviewing the scope and purpose of the department and its probable benefits to American commerce and production.

The Municipal Lighting Plant at Logansport, Ind.

It is reported from Logansport, Ind., that the disputes in the city council over the municipal electric light plant have come to a climax. Councilman Boyer charges mismanagement, and he submits figures to back up his assertions of extravagant policy. According to his showing, the surplus for 1895, the first year, was $344; for 1896, $7097; for 1897, $9674; for 1898, $6592, and for 1899 he charges a deficit of $2935. In his calculations he makes allowance for 5 per cent. depreciation yearly, and 6 per cent. interest. Mr. Boyer contends that the deficit for 1899 is a bad showing, and that the results would be different under economical management. Councilman Giffe maintains that the rates should be raised to 7 or 8 cents per kilowatt, the present rate being 5. Councilman Austin takes the same position. It has been suggested that a sinking fund be provided to meet the depreciation, and a higher rate has also been urged. The matter will probably be made an issue at the next city election.

Central Distributing Station of the Philadelphia Electric Company.

BY C. WALTON SWOOPE.

THE methods of distribution of electric current for lighting and power service in Philadelphia have been radically changed since the merging of all the different independent companies into the Philadelphia Electric Company.

Previous to this consolidation, the lighting area of the city (about 132 square miles) was supplied from thirteen separate generating stations, some companies competing for business in the same territory and operating several systems of distribution with plants containing a sundry and unique assortment of generators, boilers and engines of various sizes.

Reorganization has followed the consolidation of interests with the purpose of operating a uniform, reliable and economical system of electrical distribution throughout the city. Considerations of economy dictated the formulation of a comprehensive plan to obtain the abolishment of several of the generating plants and the substitution therefor of subdistributing stations; the installation of larger and more modern machinery in other of the stations favorably located for the project; and the addition of new and more economical generating plants.

last named plants being about nine miles distant; either of the latter loads could be carried by the Callowhill Street generator run at full load and the other generator shut down, or the total load operated from the most economical plant. The flexibility and economy are thus self-evident.

The new generating plant, on the Schuylkill River at Callowhill Street, is located in the former power house of the Hestonville, Mantua & Fairmount Railway Company. It contains four G. E. 1000-kw two-phase alternators, revolving field type, 72 poles, 100 revolutions, delivering current at 5500 volts at 60 cycles. Two of the machines are direct-connected to Greene tandem-compound engines and two to Pennsylvania Iron Works engines. One 30-kw multipolar belt-driven dynamo is driven from each engine shaft, and furnishes the field-exciting current for the alternator connected thereto. The energy is transmitted by cables through underground ducts to the high-potential switchboard located at the eastern end of the generator room, with a low-potential board and gallery just above from which the generating units and local feeders are controlled.

For lighting in the vicinity of this station the potential is reduced by static transformers to 2040 volts, but for supply to distant stations, which is the primary function of this plant, the generators are directly connected through oil-immersed cylinder rotative switches and time-limit circuit breakers to the 5500-volt high-potential busses,

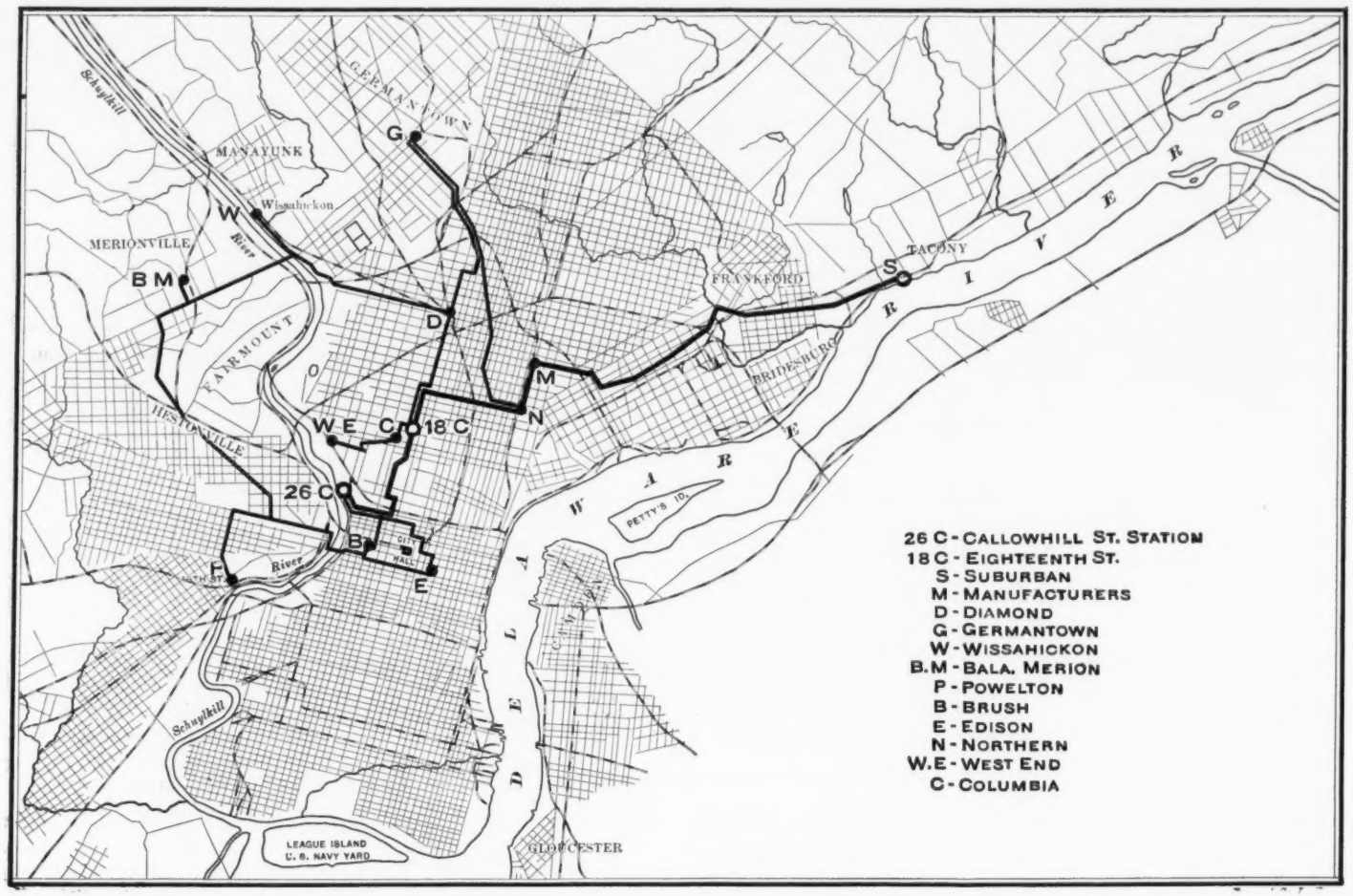


FIG. 1.—MAP INDICATING LOCATION OF PERMANENT STATIONS.

A flexible and mobile plan of operation has been attained by an intercommunicating system of tie-line feeders between the generating stations, permitting the most advantageous operation of each plant; such connections being established either directly or through a substation. Any one or more of the stations can, at certain times, be shut down, the continuity of the service being maintained by suitable switching devices through these tie-lines from another plant. This feature is extremely valuable at times of accident or excessive overload. It enables engines, generators and boilers to be overhauled without inconvenience, whenever necessary, and permits an economical loading of the most efficient station as well as a regular and uninterrupted service.

Referring to the city plan (Fig. 1) indicating the location of the permanent stations, suppose a 1000-kw alternator running at one-half load at the Callowhill Street station, with the same conditions existing at either the northern or Suburban stations, the first and from which distribution is effected through the outgoing feeders. At present five sets of feeders, each consisting of a triple-conductor cable, 115,000 c m. per conductor, and tested to 15,000 volts, transmit power on the three-wire two-phase system to the Edison central station at Ninth and Sansom Streets, where it is transformed to direct-current through rotaries, and paralleled with the Edison three-wire system supplying the principal business district of the city.

Other feeders connect the Powelton station with this plant for receiving or transmitting current, and another group terminates in the new substation at Eighteenth Street south of Columbia Avenue, a point located centrally in the northern district of the city.

The Eighteenth Street substation is of particular interest because it was especially designed and erected to meet all the requirements of a distributing centre for either the local plants displaced by it or as a medium through which the other stations of the system may be interconnected. The building contains a basement and three stories

and is substantially constructed of brick with a Colonial style front finished in terra cotta brick with Indiana limestone trimmings. The basement, first and second stories of the rear end are of fireproof construction and contain the electrical equipment. Fig. 2 gives a sectional view and plans of the interior showing the general arrangement of the apparatus. The step-down transformers, potential regulators and switching mechanism are located in the basement, the local and station feeder switchboard panels and measuring and controlling instruments being directly above on the first floor. The second floor is equipped for meter testing and repair work, while the entire third floor has been fitted up as living apartments.

The trunk line of the underground conduits passes through Eighteenth Street, and a large manhole located in front of the building affords convenient entrance into and exit from the same. The cables pass from the street into a vault underneath the vestibule, and thence through vitrified terra-cotta ducts built in with the foundation wall to the rear of the basement, where the connections are made. The electric current received into this station is distributed over their respective feeders to the systems of the following companies, viz.: Columbia, West End, Diamond, Wissahickon and Germantown. The tie-line feeders, previously mentioned, are looped into this station, and by suitable switchboard devices become available for auxiliary service if required.

The connections are made through a double set of high-potential busbars, each feeder being connected through General Electric high-potential expansion fuses by triple-pole, double-throw, oil-immersed cylinder switches, each operated by a vertical shaft of hard wood terminating in a polished hand wheel in front of the respective station panel on the first floor. Each switch shaft has an index at the floor level to designate position of switch.

For local distribution from this substation, which supplies the territory of several abolished plants, the potential is reduced to 2200 and 1100 volts by eight transformers, regulating type, of which six are of 250-kw and two of 100-kw, or a total of 1700-kw now installed. The primaries are directly connected to the high-potential busses in the same manner as the feeders, while each of the secondaries is connected through a 10-kw potential regulator to the low-potential local busbars on the first floor. The potential regulators, G. E. type, are operated from the switchboard above by sprocket chains geared to handwheels, and give a total regulation of 15 per cent.; 7.5 per cent. above and 7.5 per cent. below the normal voltage, the latter regulation being obtained by reversing the connections and boosting against the supply mains. Each of the transformers also permits of a 17 per cent. potential regulation by varying the turns in the primary winding. This is accomplished by a quick-break segmental switch located on the face of the transformer, suitably enclosed and observable through a glass plate, and operated by a handwheel and vertical wooden shaft extending to the first floor. With a constant-potential maintained by the generating station, there will thus be at this station a total regulation of 24.5 per cent. above and 7.5 per cent. below the normal voltage.

The transformers are cooled by air blast forced through a brick duct directly beneath them, the air being supplied by a blower driven by a two-phase motor. In winter the air will circulate from the top of the transformers through suitable galvanized iron ducts and heat the switchboard room above, while in summer it will be directed by a damper outside the building. A bank of potential transformers reduces the voltage of the system for connection to the voltmeter coils, wattmeter coils and pilot lamps on the local feeder panel boards, one for each phase and also for each phase of the station feeder panels. Similarly, a group of series transformers furnishes current for the ammeters and current coils of the wattmeters for the above-named circuits. The use of the transformers selected for this purpose gives rise to reduced core loss and greater accuracy of indication upon the instruments.

By means of the double set of high-potential busses, station feeder and primary switches, the local distribution may be supplied from the suburban station via the northern, while the other set of busses feed the station panels from the Callowhill Street station. The alternators in course of installation at different stations are uniform units of 1000-kw, and though it is not at present contemplated to parallel machines located at different stations, it will be noted that this may be accomplished through this substation.

The switchboard is constructed of independent panels of blue

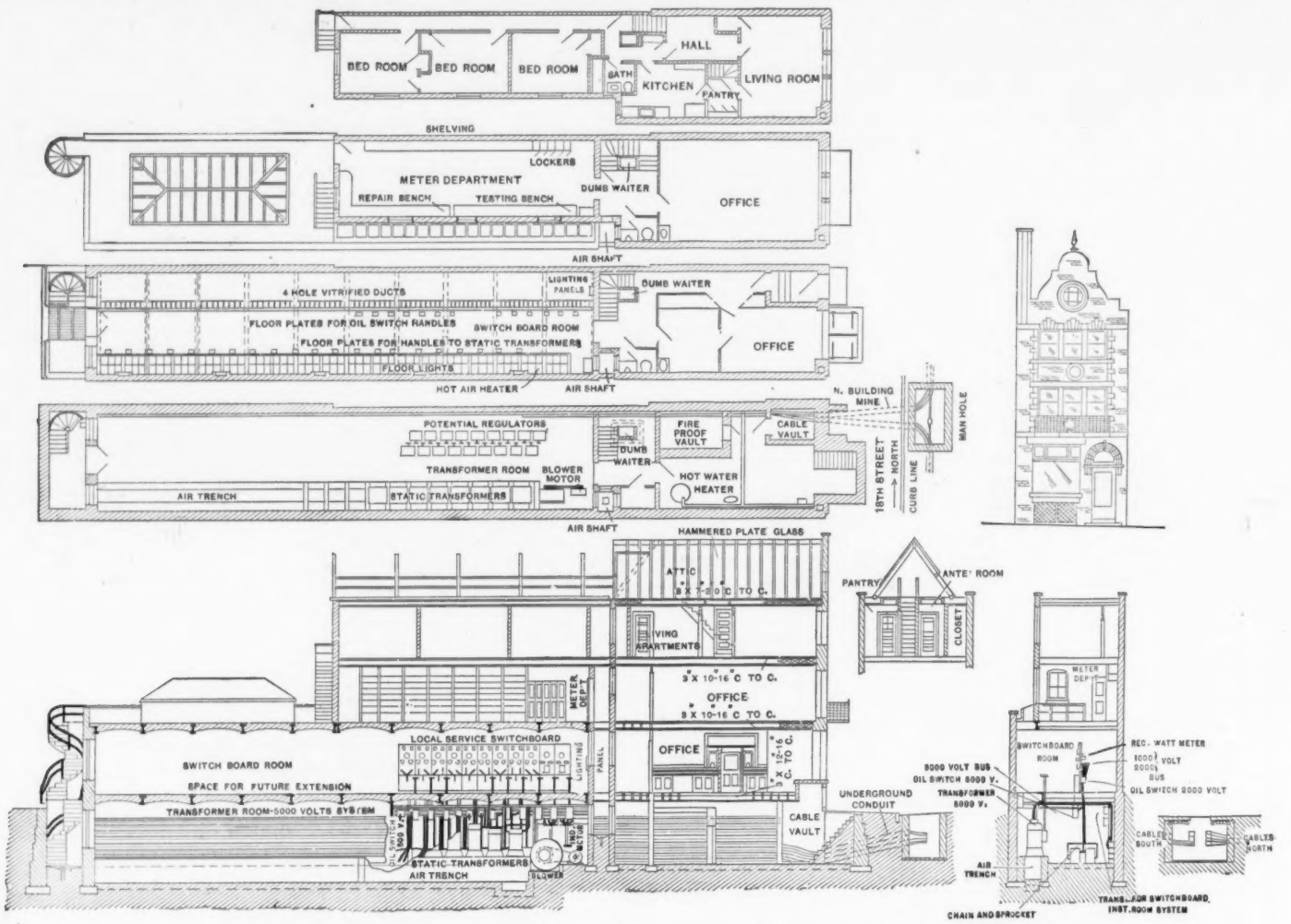


FIG. 2.—SECTIONAL VIEW AND PLANS, SHOWING GENERAL ARRANGEMENT OF APPARATUS.

Vermont marble secured to a structural iron framework which rests upon a hardwood timber laid in the cement floor. In the rear of the board short lengths of vitrified ducts are set vertically in the floor through which the cables, connecting the apparatus in the basement with the panel boards on the first floor, are drawn. Provision has been made for adding 100 per cent. to the switchboard capacity as more circuits are served from this distributing centre. Each incoming and outgoing feeder has a panel allotted, the panels being grouped for the feeders of each company's system, and containing the usual electrical instruments, including both indicating and recording Thomson wattmeters. The latter are connected in circuit in the rear of the board.

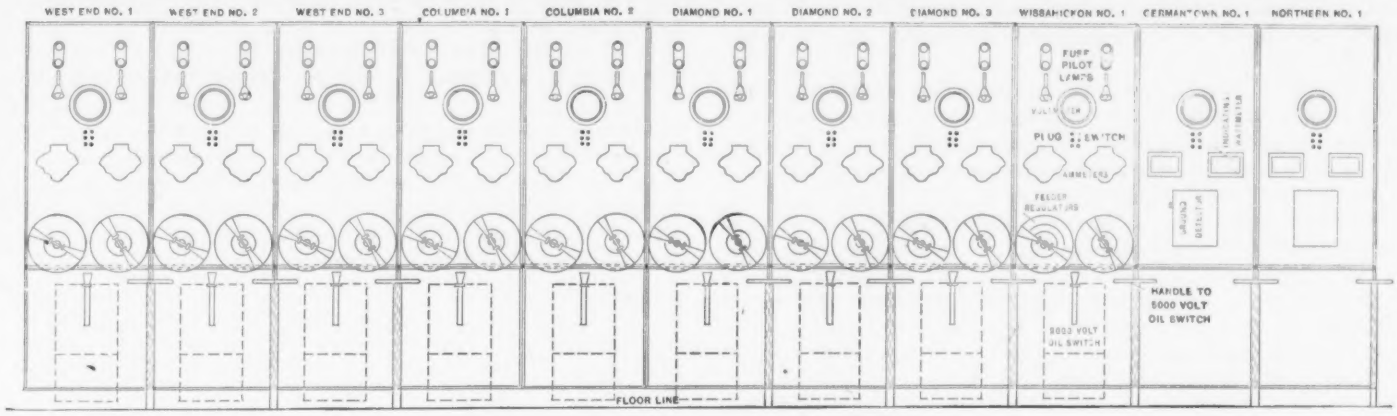


FIG. 3.—FRONT ELEVATION OF SWITCHBOARD.

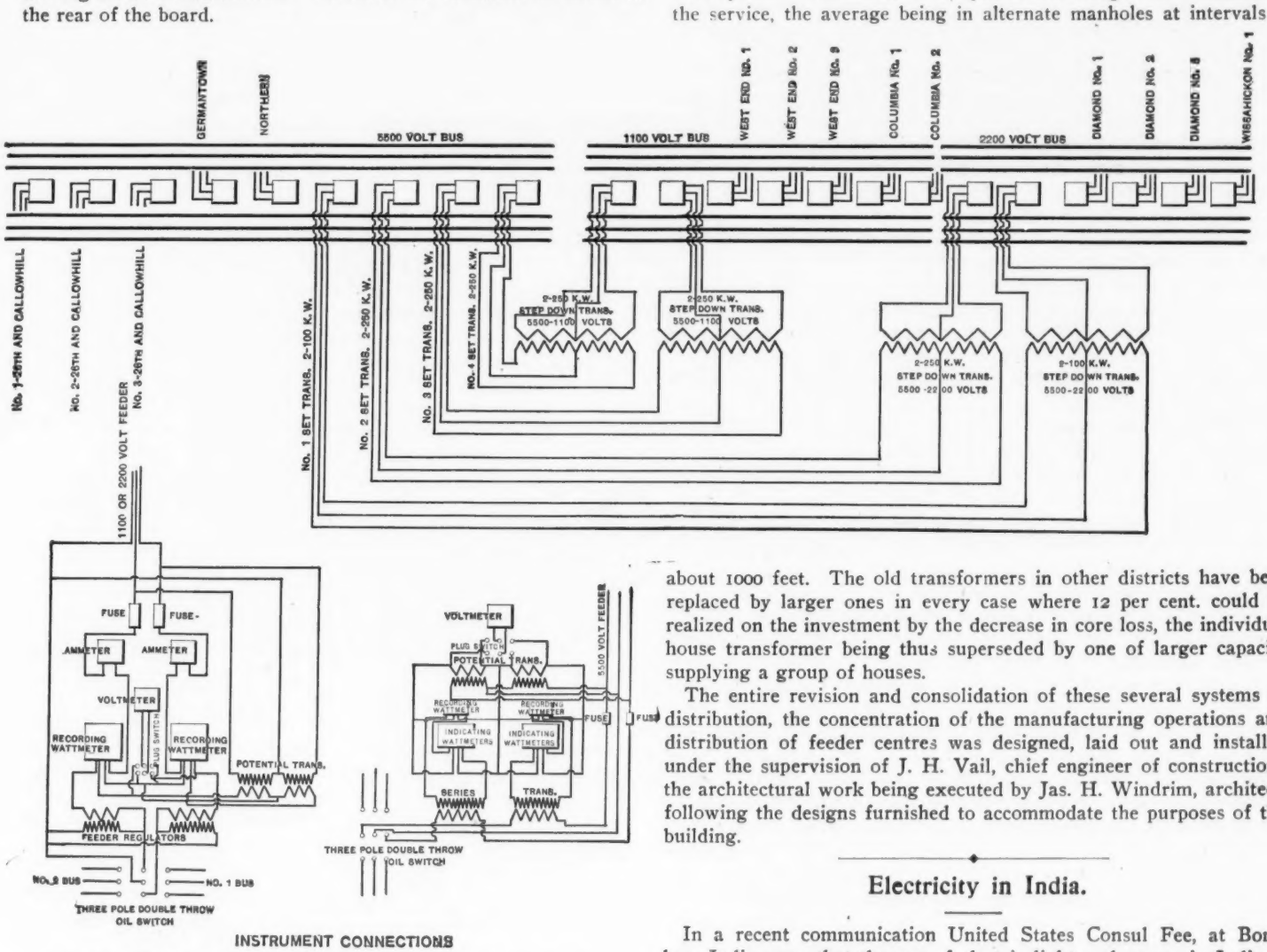


FIG. 4.—WIRING DIAGRAM, EIGHTEENTH STREET SUBSTATION.

The secondary system is connected to double sets of busbars in a similar manner to the high-potential system, the most improved appliances being used throughout the work. It was not deemed expedient to subject the older local underground feeder cables to 2200 volts potential, hence the reason for a partial operation at 1100 volts on underground feeders in one district. Another district, bounded by Vine Street, Girard Avenue, Broad and Twenty-third Streets, is laid out for a three-wire underground distribution, the Edison three-conductor tube system being employed and paralleling a system of McRoy vitrified conduits affording conveniences for placing cable feeders. In this system manholes are placed at street intersections, of sufficient size to receive two 10-kw transformers, with all the necessary cut-outs, switches and enclosed distribution panels. The intention is to develop the incandescent lighting business in this district up to a level where in the future the direct-current could be profitably employed, and then transfer the load to the Edison three-wire system. Transformers are placed according to the demands of the service, the average being in alternate manholes at intervals of about 1000 feet. The old transformers in other districts have been replaced by larger ones in every case where 12 per cent. could be realized on the investment by the decrease in core loss, the individual house transformer being thus superseded by one of larger capacity supplying a group of houses.

The entire revision and consolidation of these several systems of distribution, the concentration of the manufacturing operations and distribution of feeder centres was designed, laid out and installed under the supervision of J. H. Vail, chief engineer of construction; the architectural work being executed by Jas. H. Windrim, architect, following the designs furnished to accommodate the purposes of the building.

Electricity in India.

In a recent communication United States Consul Fee, at Bombay, India, says that the use of electric light and power in India is yet in its earliest stage, Madras being the only city using it for the operation of street cars. Bombay is poorly lighted by gas and her tramway is run by horse power. The company operating the road has its headquarters in New York and the stock is principally owned in the United States. The company has petitioned for the privilege of substituting electric power on the line. Electric lights are used in a limited way in the better class of residences and bungalows.

A Proposed System of Units.

BY PROF. REGINALD A. FESSENDEN.

In a recent number of the London *Electrician* (Dec. 29, 1899), there appeared a reprint of a note of mine on a proposed system of units. As, however, the original, which was printed in these columns, contained some misprints, and as I now see, was not explicit enough in regard to some points, I would like to deal with the matter more fully.

First, I would emphasize the fact that this proposed system is suggested as an *alternative* in case the system proposed by Heaviside cannot be carried out. His system is undoubtedly the best, and it will ever be a matter of regret that it was not adopted originally. If it should appear that there is any probability of carrying out Heaviside's original method, I am too ardent an admirer of his work and have too much confidence in his judgment to do otherwise than withdraw my suggestion. It is only in case the opposition on the part of the governments and of the manufacturing firms proves too strong that this alternative is put forward.

At present we have two units of quantity of magnetism, i. e., the unit pole and the line. We have one unit of magnetic intensity, i. e., the gilbert (adopting for the present the name suggested by the Amer. Inst. E. E.)

The ratio "magnetic lines per sq. cm. ÷ magnetic intensity" is called the "permeability." The ratio "quantity of magnetism per sq. cm. ÷ magnetic intensity" has no name at present (though the ratio "intrinsic magnetism per sq. cm. ÷ magnetic intensity is called the susceptibility). In the present paper I will call this ratio the "permity."

Since it takes 4π lines to make unit quantity of magnetism, when a substance has its permity 1, its permeability will be 4π.

Having two units of magnetic quantity, the ratios between these units and the other electric and magnetic quantities give us a double set of terms, one set of terms being 4π times as large as the other. Evidently, if we make the magnetic line and the unit pole of the same size we will do away with one set of these terms.

Similarly we have two units of electric quantity, i. e., the line of electrostatic flux and the unit charge.

The ratio "electric flux lines per sq. cm. ÷ electric intensity" is called the "specific inductive capacity."

The ratio "quantity of electricity per sq. cm. ÷ electric intensity" has no name, and in this paper I will call it the "capity."

Since there are 4π electrostatic lines to unit charge, when a substance has unit specific inductive capacity its capity is $\frac{1}{4}\pi$.

Here also we have a double set of units, one set of which can be done away with.

Consider now the equation

$$\text{Q. P. (curl)} /T = ML^3 /T^3.$$

Since the 4π gets in through the curl, we can get rid of the 4π in three ways:

1. Splitting it up between the Q and the P (Q being quantity of electricity and P quantity of magnetism); i. e., making Q and P both $1/\sqrt{4\pi}$ times as large as at present.

2. Keeping both Q and P the same size as at present, but making the unit of work 4π times as large as the present erg.

3. Making Q $\frac{1}{4}\pi$ times as large as at present, keeping the other terms the same size.

4. Making P $\frac{1}{4}\pi$ times as large as at present, keeping the other terms as at present.

The first method is Heaviside's original proposal. It is the ideal method. It, however, necessitates changing the ampere, ohm, volt, farad, henry, coulomb and other units.

The second and fourth methods are impracticable.

The third method is the one I propose. It necessitates the following changes.

1st. Making the unit quantity of magnetism $\frac{1}{4}\pi$ times as large as at present, i. e., equal in size to the present magnetic line. This would result in no inconvenience; is, in fact, legalized now, for the henry is 10^9 lines and not 10^9 units of magnetic quantity. It is also very generally used in practice.

2d. Making the absolute unit of current turn (i. e., ten ampere turns), the unit of gilbertance (i e., difference of magnetic potential). We may call it the amma-turn.

3d. Making the permity of air 4π instead of $\frac{1}{4}\pi$ as at present.

This would cause no inconvenience, as no one designs magnetic mechanisms from printed tables. Every piece of iron must have its magnetic constants determined as it comes into the shop, as no two heats are the same magnetically.

4th. Doing away with the term specific inductive capacity, and using the capity instead, the capity of air being $\frac{1}{4}\pi$.

This also would cause no inconvenience, for no one would think of using capacity tables to determine the capacity of a cable or condenser, and in every cable manufactory these are determined by experiment. In general the values given in tables are higher than those found in practice. For example, Fleeming Jenkin gives for pure rubber k = 2.80, and Salford and Halman give it as 3.7, while cable makers will, by treating it so as to remove all mechanically entrained moisture, furnish it as low as 2. And in any case, in calculating the capacity one has to first multiply by 4π, in using the present tables, so that this is equivalent to using the capity.

The following table shows the relation between the present and proposed systems:

PRESENT.	PROPOSED.
Ampere,	No change.
Coulomb,	"
Volt,	"
Ohm,	"
Farad,	"
Henry,	"
Erg, Joule, Watt,	"
Unit of magnetism,	$\frac{1}{4}\pi$ of present, i. e., = mag. line.
Permeability,	Use Permity instead, which for air has the value 4π.
Spec., Ind., Cap.,	Use Capity instead, which for air has the value $\frac{1}{4}\pi$.
Magnetic Potential,	4π times present, i. e., = absolute unit turn, i. e., amma-turn.

PRESENT FORMULAE.	PROPOSED FORMULAE.
$QQ'/kL = PP'/mL$ = Force.	$QQ/4\pi\kappa L = PP/4\pi\mu L$ = Force
$D_1^2/8\pi k$ = W per c. c.	$D^2/2\kappa$ = W per c. c.
$B^2_1/8\pi m$ = W per c. c.	$B^2/2\mu$ = W per c. c.
$G = 4\pi nI$.	$G = nI$.
$E = d(4\pi P)/dt$.	$E = dP/dt$.
$K = k\, s/4\pi t$.	$K = \kappa\, s/t$.

Where Q represents quantity of electricity.
D_1 represents electrostatic flux per sq. cm.
D represents quantity of electricity per sq. cm.
P represents quantity of magnetism.
B_1 represents magnetic flux per sq. cm.
B represents quantity of magnetism per sq. cm.
W represents energy.
k represents specific inductive capacity.
κ represents capity.
m represents permeability.
μ represents permity.
K represents capacity (i e., capance).
G represents magnetomotive force, i. e., gilbertance.
E represents electromotive force, i. e., voltance.

In the present system we have

$$1/\sqrt{k\,m} = \text{velocity of light.}$$

In the new system, since the permity for air (or vacuum) is 4π and the capity is $\frac{1}{4}\pi$, we have

$$1/\sqrt{\kappa\,\mu} = \text{velocity of light in air (or vacuum.)}$$

We have now got a system of units which is perfectly rational, so far as the absolute units are concerned. Dr. Fleming, in an extremely able article,* has extended this system by forming a new system of practical units. By making the practical unit of current ten times as large as the present ampere, the ohm one-tenth the size, the unit of energy ten times as large, etc., he obtains a very convenient and simple system of practical units, and one which is much superior to the present system.

I have not, myself, considered the subject of practical units, for the reason that, as stated in my previous note, I do not believe in practical units. If any system of practical units is to be chosen, then Dr. Fleming's system has many advantages over the others. But I fail to see the use of the so-called practical units. In dealing with lengths, for instance, we have the meter as our standard. Physicists use the centimeter more frequently, but we have not found it necessary to make it a practical unit and call it the "Michaelson," nor

*See London *Electrician*, Dec. 29, Jan. 5, 12 and 19. Also Digest, Feb. 3 and 10, and following abstract.

have our engineers found it necessary to make a "practical unit" out of the kilometer and call it a "Euclid." I should be glad to know what advantage has accrued to the electric profession from the action of our unit makers in taking one-tenth of absolute magnetic unit of current as the practical unit of current and calling it the ampere. Has it not rather been a source of nuisance without any corresponding benefit? Why not then go back to our absolute units of current, voltage, etc., and by making suitable prefixes or suffixes, obtain what sizes we desire, just as we do in the case of the meter? I subjoin such a scheme, not that I think it cannot be improved upon, but merely as to show the general idea.

1. Denote absolute electrostatic units by the suffix sta. Thus
Volsta = absolute E. S. unit of voltage.
Coulsta = absolute E. S. unit of quantity, etc.
2. Denote absolute magnetic units by the suffix ma. Thus
Volma = absolute electromagnetic unit of voltage.
Coulma = absolute electromganetic unit of quantity.
Amma = absolute electromagnetic unit of current. Etc.
Denote space differentials by the suffix l. Thus
Volstal = volstas per cm.
Denote area differentials by the suffix r. Thus
Coulstar = coulstas per sq. cm.
Denote volume differentials by the suffix v. Thus
Ergav = ergs per cubic cm.
Denote time differentials by the suffix t. Thus
Coulmat = coulmas per second.

Let the prefix l or le denote the 1/1000, the prefix m or me the 1/1000.000, and the prefix n or ne denote the 1/1.000.000.000 of the absolute unit. Let the prefix r or re denote 1.000, the prefix s or se 1.000.000, and the prefix t or te denote 1.000.000.000 times the absolute unit. Thus.

1 tohma represents the present ohm.
11 tevolmas represent 110 volts (or, tolmas).

I have no doubt but that some of the gentlemen who have paid attention to question of nomenclature could improve upon these terminations and prefixes. Our French colleagues, especially, are rather fortunate in dealing with such questions, and so, as I mentioned previously, the above is merely given as showing the general methods.

It will be noted that I speak throughout of the permity, not the permeability, as being 4π for ether. This is because the strict definition of permeability is that it is the constant m in the expression

$$PP'/L^2m = \text{Force},$$

and hence with our new unit of magnetic quantity, the new permeability is by strict definition equal to $(4\pi)^2$ while the permity or the coefficient in the expression

$$PP'/4\pi L^2\mu$$

is 4π for ether. Dr. Fleming uses the term permeability as the ratio B/H, which is identical with the permeability in our present system, and is the permity in my proposed system. Hence the supposed discrepancy.

For another reason I prefer the term permity, and that is, that I believe the retention of the old term will cause confusion. Moreover it is inconveniently long.

In the discussions of the proposed system which have appeared previous to Dr. Fleming's admirable paper, I have been struck by two things: First, the uncertainty as to whether the air or the ether is the substance of permeability unity. There is reason for this confusion, and the following list will be instructive:

Author.	Substance permeability 1.	Substance spec. in. cap. 1.
Maxwell.	Ether.	Ether.
Faraday.		Air.
J. J. Thomson.	Air.	Air.
Everett.	Ether.	Air.
Webster.	Ether.	Ether.
Lodge.	Air.	Air.

The actual facts of the case are, I believe (though I stand subject to correction), that *air* is the substance of specific inductive capacity unity, and that there has been no authoritative statement as to what substance should be considered as having unit permeability.

Another point which has somewhat surprised me, is the very general idea that there is something incorrect in making the permity of air 4π. To quote one of my critics, "The objection would be that the permeability of any substance would no longer be its specific magnetic inductivity with respect to the inductivity of the standard dielectric, namely, ether, but with reference to an imaginary body whose inductivity was 4 ." This idea, as has been pointed out by Prof. Fleming, is entirely incorrect.

As Lodge has shown, whatever the permeability of the ether is, it most certainly is not unity, and so we have just as much right to take its permeability as $(4\pi)^2$ as to take it as unity. In fact there are some advantages in doing so, for it is evident, from the criticism referred to, that the fact that both the permeability and spec. ind. cap. are now taken as unity for the ether has led some to overlook a point to which Lodge has called attention, i. e., that *both* are arbitrary assumptions, and *both* cannot be true. If we say, "let the permity of the ether be 4π and its capity be $\frac{1}{4}\pi$", they *are* 4π and $\frac{1}{4}\pi$ respectively, just as much as the permeability and spec. ind. cap are now unity. We are not in the least taking any liberties, and, in fact, since, if I am not mistaken, the substance of unit permeability has never been authoritatively settled, the subject is still wide open, and we are not revoking the decisions of any scientific congress. From the conflict of authorities pointed out above, it is high time we decided to fix upon the value of the permeability for air.

In the paper referred to in my previous note ("A Determination of the Nature of the Electric and Magnetic Quantities, and of the Density and Elasticity of the Ether," *Physical Review*, January, 1900), in an appendix which will appear in March, I have given some details of this system, and suggested symbols and a nomenclature. The symbols, I think, will be found very convenient, but the nomenclature is meant merely as an illustration of the method.

To sum up, we have our choice of four methods:

1. Heaviside's. The advantage of this system is that is gives a perfect and rational system of units and simplifies calculations very much.

Its disadvantages are that it necessitates the changing of the legal units of current, voltage, capacity, resistance, etc. It also necessitates the changing or the throwing away of all our present resistance boxes and standards of current, and the recalibration of many other electrical instruments, such as ammeters and voltmeters. Moreover, all the vast mass of electrical literature which we have accumulated during the past twenty years will be rendered somewhat inconvenient of reference, for when in the course of our reading we find, say, ten amperes mentioned, we will have to divide the ten by 1.7724 in order to get the value in terms of the new units. This will make considerable arithmetical work. And lastly, since it has been but recently that the present units were legalized, we can hardly expect our governments to change them again, after being in use for so short a time, at once. It may be doubted if they can be induced to take action within ten or twenty years.

2. To go ahead with our use of the present absolute and practical units. This means a loss of time of about three-quarters of a year (according to my experience) for every electrical engineering graduate, and the perpetual annoyance of a complicated, irrational and vexatious system of reckoning.

3. The writer's method. The advantages of this system are that it gives a simple and rational system of units, the equations and formulæ being identical with those of Heaviside's system, the only difference being that a different medium is chosen as having unit permeability. It disturbs none of the legal units, it necessitates no changes of calibration and no loss of apparatus, and renders useless no printed tables which are used in practical work. The whole change is merely one of definition, and if the proposed changes were made by the Paris Congress to-morrow, there would be absolutely no disturbance, the only difference being that we would write our equations in a simpler form. It is curious to note that, as if by instinct, designers have been tending towards this system, for in most works the ampere-turns are used instead of the gilberts, and the henry has been chosen as being a certain number of magnetic lines instead of a certain amount of magnetism. Moreover in electrostatic problems we have for years been using the capacity, which is analogous, not to the permeance, but to 4π times the permeance.

As regards the present legal practical units, there is absolutely no need of touching them; we simply use absolute units instead. The yard and the meter are the absolute units of length, but as a matter of fact, we use the yard and meter less than any other units of length, yet it does no harm. It is not necessary to sell current by amperes any more than it is necessary to sell land by the yard. Still we can do so if we choose.

The disadvantage of the system is that in place of the time honored fiction that the ether has unit permeability and spec. ind. capacity, we substitute another fiction, i. e., that the permeability is $(4\pi)^2$ or the

permity is 4 π. We have just as much right to make the one supposition as the other (both being incorrect, as a matter of fact). The injury done is hence of a purely sentimental character.

4. We may use the above system, and make in addition a new system of practical units. This is the plan proposed by Prof. Fleming. The advantage of this system is that we get a good system of practical units, and all our present electrical instruments and standards are still available.

The disadvantage, if there is any, is that it is not evident that practical units are anything but a nuisance and a source of confusion. As regards this point, there will be diversity of opinion.

If we adopt either of the two last systems, there is no reason why we should not do so at the Paris conference this year.

Our Electric Units: What Shall We Do with Them?*

Mr. Oliver Heaviside has shown that the centimeter-gramme second system of electric and magnetic units labors under certain defects by reason of an inexpedient choice of the fundamental units. In his own writings he rectified these defects and substituted an amended system of units which he called a system of "rational units." In this system the unit of

Electromagnetic dimensional formula.		
$L^{3/2} M^{1/2} T^{-1} \mu^{1/2}$	Magnetic pole	$= \frac{1}{\sqrt{4\pi}} \times$ (The present *C. G. S.* unit magn. pole).
$L^{-1/2} M^{1/2} T^{-1} \mu^{-1/2}$	Magnetic force	$= \sqrt{4\pi} \times$ (The present *C. G. S.* unit mag. force).
$L^{3/2} M^{1/2} T^{-1} \mu^{1/2}$	Magnetic flux	$= \sqrt{4\pi} \times$ (The present *C. G. S.* unit mag. flux).
$L^{1/2} M^{1/2} T^{-1} \mu^{-1/2}$	Current	$= \frac{10}{\sqrt{4\pi}} \times$ (The present amp.).
$L^{3/2} M^{1/2} T^{-2} \mu^{1/2}$	Electromotive force	$= \sqrt{4\pi} \times$ (The present volt).
$L T^{-1} \mu$	Resistance	$= \frac{4\pi}{10} \times$ (The present ohm).
$L \mu$	Inductance	$= \frac{4\pi}{10} \times$ (The present henry).
$L^{1/2} M^{1/2} \mu^{1/2}$	Quantity	$= \frac{10}{\sqrt{4\pi}} \times$ (The pres. coulomb).
$L^{-1} T^{2} \mu^{-1}$	Capacity	$= \frac{10}{4\pi} \times$ (The present. farad).
$L^{1/2} M^{1/2} \mu^{-1/2}$	Magnetomotive force	$= \frac{10}{\sqrt{4\pi}} \times$ (The present amp.-turn).
$L^{2} M T^{-2}$	Power	$= 10 \times$ (The present watt).
$L^{2} M T^{-2}$	Energy	$= 10 \times$ (The present joule).

These rational units of Heaviside would form a much more convenient system than the present system, but would involve a radical change, not only in our existing nomenclature, but also in our electrical apparatus.

By comparing the dimensional formula of the unit with the Heaviside reduction-factor in the above table it will be observed that, neglecting decimals, wherever μ appears in the former 4 π appears in the latter; excepting the first pair (magnetic pole and force). Consequently, as Prof. Fessenden has recently suggested, we might rationalize our present units in regard to the 4 π factor by taking the permeability of ether as unity, excepting the units of pole and force. By making the unit pole 4 π times smaller and the unit magnetic force 4 π times larger, these exceptions would disappear and the whole system would be rationalized with respect to 4π without altering anything but our conventions concerning the permeability of ether, our tabulated list of permeabilities of magnetic substances, and our magnetic units of force and pole.

The decimal factors could also be introduced by making

The present dekampere the new ampere.

The present dekacoulomb the new coulomb.

The present dekampere-turn the new unit of m. m. f.

The present dekawatt the new unit of power.

The present dekajoule the new unit of energy.

The present dekafarad the new unit of capacity.

The present deciohm the new ohm.

The present decihenry the new henry.

The volt and the unit of magnetic flux or C. G. S. line would remain unaltered.

The units would then be as follows:

Proposed name for the new practical unit.	Equivalent in present reckoning to	Equivalent to the below stated numbers of present *C. G. S.* electromagnetic units.
New ampere	1 dekampere	1
" coulomb	1 dekacoulomb	1
Line	1 line of force	1
Volt	1 volt	10^8
New ohm	1 deciohm	10^8
" henry	1 decihenry	10^8
" watt	10 watts	10^8
" joule	10 joules	10^8
" farad	1 dekafarad	10^{-8}
Gauss	1 dekampere-turn	4π
New unit of magnetic force	1 dekampere-turn per centimeter	4π
New unit of magnetic pole strength		$\frac{1}{4\pi}$

The advantages of the above system of units would be:

1st. That it would be a rational system, in which 4 π would disappear from the ordinary equations.

2. That the decimal relation or power between the practical unit and the C. G. S. unit would be either zero or eight.

3. The new practical units would all be of a more convenient magnitude to practical electricians, except perhaps the new farad.

4th. No material difficulty would be presented in changing the calibration or scales of existing apparatus to conform with the new quantities.

5th. In the magnetic circuit, the magnetomotive force would be the ampere-turns simply and not 4 π times the ampere-turns.

6th. Nearly all magnetic formulas would be simplified and elucidated.

Electrician, Dec. 29, 1899, Jan. 5, and Jan. 12, 1900.

*Abstract of a serial article by Dr. J. A. Fleming, F. R. S., appearing in the

Fence Wire Telephony in Indiana.

A great deal is said from time to time in the daily papers about fence wire telephony, the idea being apparently that there are vast possibilities in that direction. It would seem, however, that such work must be necessarily more or less limited. Mr. Cassius Alley, of Pendleton, O., who has shown his ingenuity in the bicycle field, has sent us some details about a line that he constructed not long ago between the towns of Ingalls, Pendleton and Anderson, a distance of little more than fifteen miles. The exchange was started on Jan. 1, the instruments used being those of the Kokomo Electric Company and the American Telephone & Electric Company. Mr. Alley uses for conductor the ordinary barbed wire, it being the top wire of the "Big Four" Railroad Company's fence, except where it runs within the corporate limits of the several towns. There he uses a light pole and insulator "which reduces the cost of line building one-half and at the same time makes a better line." Where the fence is high and the roadway intersecting the railroad is low, the wire is carried over on two poles, so that wagons can pass underneath freely. Where the fence is low and the road is high the telephone wire is carried below the road level. As a matter of fact, the line crosses six railroads, three times under and three over, and no fewer than 37 country roads, sometimes under and sometimes over. Mr. Alley asserts that the expense of building this line, not including the wire on the fence, will not be in excess of $100. This estimate naturally does not include five sets of telephone instruments connected in series. Mr. Alley remarks: "We claim nothing new in our system unless it be the painting of some of the joints where the conducting wire is stapled to poles. Our success in wet weather depends of course on this rubber paint which keeps the points or fastenings dry, and therefore prevents grounds." Where the circuit passes under roads it is rubber covered wire placed inside gaspipe. The rates charged are $25 per year and 10 cents a message for toll line. In the early spring there are to be metallic circuits to several smaller towns and hamlets, trying some other methods of cheap telephonic development.

The Drop in Alternating-Current Wires.*

By Cecil P. Poole.

IT seems rather odd, in the light of present knowledge of alternating-current phenomena, that the effect of inductance upon the drop in alternating-current circuits should be treated as negligible in laying out lines of the lengths and character usually found in central station plants. That the inductive effect is really negligible in only a small proportion of primary feeders is, or should be, a well-known fact, especially as regards high frequency systems—133 to 140 cycles. One of the arguments usually advanced in support of this neglect of inductance is that the power factor of the load cannot be determined for plants comprising one or more primary networks supplying transformers, the secondary load of which is chiefly lamps, with a sprinkling of arc lamps, fan motors, and an occasional larger motor.

This is true, of course, but it is also true that a much nearer approach to accuracy can be attained by assuming a load power factor somewhere near unity and figuring the feeders on this basis than by ignoring power factor, inductance and all. It was the writer's practice, some years ago, before the advent of practical alternating-current motors, to calculate 1000-volt primary lines on the arbitrary basis of a load (meaning the transformers) power factor of .95, and

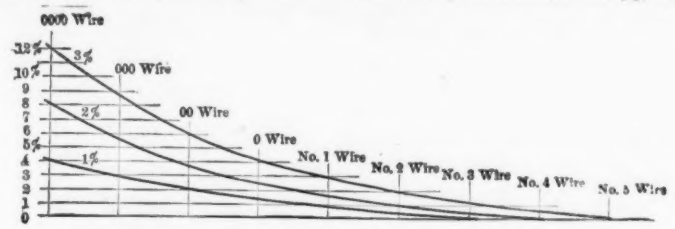


FIG. I.

the actual results were always a trifle better than the figures predicted, showing that the assumed power factor was a little low. Since then it has been determined by observation that the load power factor of such circuits ranges from .97 to above .99 when the secondary circuits are at normal load during the "full-load" period of the daily run. With modern transformers, therefore, the assumption of a power factor of .98, say, cannot entail an error of objectionable magnitude. On this basis the difference between the energy drop and the actual drop is seldom negligible, if decent regulation on several feeders in parallel is to be secured. A feeder of No. 0 wire, carrying current at 133 cycles and showing an energy drop of 5 per

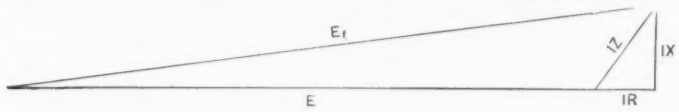


FIG. 2.

cent. will show an actual drop of 7.25 per cent. if strung 6 inches apart; 7.6 per cent. if 9 inches apart, and 7,75 per cent. at 12 inches.

This recalls a case in point that came within the writer's observation several years back. A 1000-volt lighting system, single-phase, was extended by the addition of a feeder which was to serve a separate distribution main in the usual manner. The new feeder was to carry 55 amperes a distance of 2900 feet, roundly, and the drop was to be as near 4 per cent. as possible, that being the drop over the other feeders in parallel with which the new one was to be supplied. The perennial primary line table purporting to give the drop for all sizes of wire showed that No. 1 wire would fill the requirements most beautifully. So the feeder was strung (12 inches between centres) and inconsiderately refused to deliver the required e. m. f. at its far end; the actual drop measured 5.75 per cent. instead of 4 per cent.

In most interior wiring the inductance drop may be ignored, the only cases in which its recognition is desirable being those requiring the use of wires larger than No. 2, B. & S. gauge. This is shown by Fig. 1, which is a set of curves giving the relation between the energy drop of wires 3 inches apart, and the increase in drop due to inductance at 133 cycles. The ordinates are standard wire sizes and the abcissæ are increments of increase in per cent. of the energy drop, which is represented by the curves. Thus, if the load on a No. 0000 feeder is such as to give an energy drop of 2 per cent., the drop will be increased 8 per cent. of the energy value, making the actual drop 2.16 per cent. The diagram shows that there is no increase in the drop of No. 3 wire when the energy drop is 1 per cent.; none in No. 4 wire when the energy drop is 2 per cent., and none for No. 5 wire when the energy drop is 3 per cent. The wires are assumed to be 3 inches apart, and carrying a non-inductive load, which is a common condition of interior wiring on ceilings and in mouldings.

Of course, a power factor changes the relations tremendously. Assuming a fixed e. m. f. at the load, a frequency of 133 and wires 3 inches apart, a pair of No. 2 wires showing an energy drop of 2 per cent. with a load power factor of unity shows an actual drop of only 2.02 per cent. But if the load have a power factor of .90 with exactly the same current value as before the actual drop goes up to 2.25 per cent. And if the load be changed to one of the same value in real watts, with a power factor of .90, the drop goes up to nearly 3 per cent.

It is hardly necessary to state that where power transmission over a distance of any magnitude is concerned, full consideration is given to the inductive effect upon the line drop, but it seems to the writer very peculiar that nearly all of the curves, tables, etc., relating to this subject that have thus far been published are based upon the impedance of the line wires instead of their resistance and reactance separately considered. Just why this is so is obscure. For the purpose of ascertaining the e. m. f. required at the busbars of a generating station in order to deliver a given load at a given e. m. f. over a given distance and line the simplest and most convenient method is to add together all of the energy components of the elements of the complete circuit, similarly add together the inductive or imaginary components of the elements and take the vector sum of these two arithmetical sums. In short, to use the general formula:

$$\sqrt{(\Sigma V)^2 + (\Sigma IX)^2} = E_t,$$

in which V is the IR drop in one element of the circuit and IX is the reactive e. m. f. of one element, X being the reactance of an element. E_t is the busbar e. m. f. In the case of a line supplying a

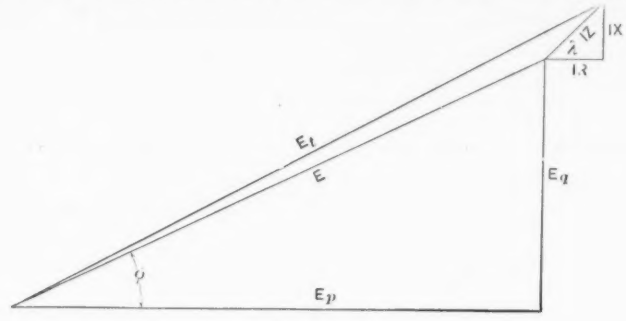


FIG. 3.

transformer, the load of which is non-inductive, the above formula expands into

$$\sqrt{(Ep + IR)^2 + (Eq + IX)^2} = E_t,$$

and if the drop in terms of the delivered e. m. f. be desired, this formula transposes into

$$\sqrt{\left(p + \frac{IR}{E}\right)^2 + \left(q + \frac{IX}{E}\right)^2} - 1 = D,$$

in which formulas E is the e. m. f. at the primary terminals of the transformer; I, the line current; R, the line resistance; X, the line reactance; p, the power factor of the transformer; q, its inductance factor (the sine of that angle of which p is the cosine), and E the e. m. f. at the load. $D \times 100$ = the drop in per cent. of the e. m. f. at the transformer.

When the transformer supplies a motor through secondary wiring of any length at all, the calculation is simply elaborated, but the writer cannot conceive a practical case in which any consideration of line impedance simplifies or facilitates the computation or anything else in connection with the over-all drop or the e. m. f. required at the busbars. And certainly the impedance of any one part of the whole circuit is of extremely small importance or interest, if any, when divorced from the balance of the circuit. Where, then, does line impedance come in, and of what use are extensive tables of such values for line wire?

The above formulas may look forbidding, but in reality they are very convenient of application, with the assistance of a table of

*In the Electrical World and Engineer for Nov. 18, 1899, there appeared an article by the writer under this heading. The article contained so many typographical errors, however, as to render it in parts unintelligible. For this reason it has been incorporated in the present article, of which it forms the greater part.

squares and roots and one of reactances. Tables of squares and roots abound in many handbooks; tables of reactances are given herewith which cover the two frequencies most generally used in this country. These are the only ones of which the writer knows that covers both frequencies and in which the values are carried beyond three decimal places.

TABLE III.

Power Factor. p	Inductance Factor. q	Angle of Lag.	Power Factor. p	Inductance Factor. q	Angle of Lag.
.70	.7142	45°34	.85	.5267	31 47
.71	.7042	44 46	.86	.5103	30 41
.72	.694	43 57	.87	.493	29 32
.73	.6835	43 7	88	.475	28 21
.74	.6726	42 16	.89	.456	27 8
.75	.6614	41 25	.90	.436	25 51
.76	.65	40 32	.91	.4147	24 30
.77	.638	39 39	.92	.392	23 4
.78	.6258	38 44	.93	.3675	21 34
.79	.6131	37 49	.94	.341	19 57
.80	.60	36 52	.95	.3123	18 12
.81	.5864	35 54	.96	.28	16 16
.82	.5724	34 55	.97	.243	14 4
.83	.5578	33 54	.98	.199	11 29
.84	.5426	32 52	.99	.141	8 6½

Table III. gives the inductance factors and angles of lag corresponding to numerous power factors, the latter being given round numbers. The writer hopes to be pardoned for considering this table much more convenient than the usual form which gives the power and inductance factors corresponding to angles, the power factors being, therefore, mixed numbers and consequently less convenient to use in computations.

Another curious fact in connection with alternating-current drop is that many persons who should know better labor under the misapprehension that the drop in line wires is directly proportional to the line impedance; that one needs only to multiply the IR drop by a line impedance factor in order to ascertain the drop in volts. The falsity of such an impression is apparent upon inspection of Figs. 2, 3 and 4. Fig. 2 is a vector diagram of the differences of potential of a pair of wires and a non-inductive load; Fig. 3 is a similar diagram for a pair of wires and an inductive load (motor), and Fig. 4 is a diagram of the same character in which the load and the line wires have the same power factor, or more accurately stated, when the ratio $\frac{Z}{R}$ is equivalent to p.

It is perfectly obvious that only in the last case does the drop, V, bear a simple relation to the line impedance; here it is equal to IZ. Not only is this the only case wherein this relation holds, but the ratio of IZ to D changes with (1) every change in the ratio of Ep to IR; (2) every change in the ratio of Eq to IX; (3) every change in the ratio of p to q, and (4) every change in the ratio of R to X, unless *all* of these ratios simultaneously and proportionately change. In short, every change in the ratio between two angles, λ and ϕ changes the ratio between the line impedance and the actual drop, and what is worse, neither the drop nor the ratio $IZ : D$ is a straight line function of any interrelation of the angles.

It is true that the line impedance may be made a factor in the computation of the drop, by using the formula

$$\sqrt{E^2 + I^2 Z^2 + 2 E I Z \cos(\lambda \sim \phi)} - E = V$$

but this is not a thing to be contemplated joyously. The angle λ must be fished out with the help of equation

$$\text{secant } \lambda = \frac{Z}{R} = \text{line impedance factor};$$

and it usually develops to be some such attractive combination as 24° 36′ 27½″ (as a matter of fact this is almost exactly the angle for No. 4 wires, 12 inches apart, at 133 cycles). Then the cosine of the difference between the lag angle of the motor and the ornamental

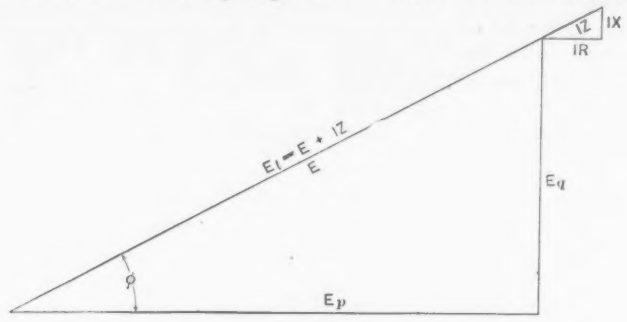


FIG. 4.

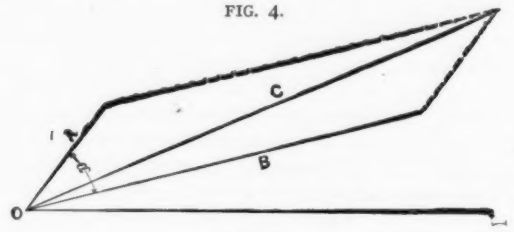


FIG. 5.

array just mentioned must be fished out. Then, if one has not forgotten at just what part of the performance he has arrived, the remainder of the solution is comparatively convenient. Of course, none of it is mathematically difficult.

TABLE I.—REACTANCE PER 1000 FEET OF CIRCUIT AT 60 CYCLES.

Size of Wire.	Distance from centre to centre of wires, in inches.								
	2½	3	4	6	9	12	15	18	24
0000	.12118	.12938	.14278	.16142	.18000	.193277	.203534	.211914	.225136
000	.12648	.13487	.14809	.16672	.18536	.198585	.208841	.217219	.230440
00	.13182	.14020	.15342	.17206	.19069	.203912	.214169	.222551	.235773
0	.13713	.14552	.15873	.17737	.19601	.209230	.219487	.227867	.241090
1	.14247	.15085	.16407	.18271	.20135	.214571	.224827	.233207	.246430
2	.14780	.15618	.16940	.18804	.20668	.219901	.230157	.238537	.251760
3	.15313	.16150	.17474	.19337	.21201	.225233	.235486	.243866	.257092
4	.15846	.16684	.18006	.19870	.21733	.230558	.240815	.249196	.262417
5	.16379	.17217	.18539	.20402	.22266	.235887	.246144	.254524	.267746
6	.16912	.17749	.19072	.20935	.22799	.241217	.251472	.259852	.273076
7	.17445	.18282	.19605	.21469	.23332	.246539	.256805	.265182	.278405
8	.17978	.18816	.20138	.22001	.23865	.251876	.262130	.270511	.283735
9	.18510	.19348	.20670	.22531	.24398	.257200	.267455	.275837	.289059
10	.19044	.19882	.21204	.23071	.24931	.262536	.272791	.281172	.294395

TABLE II.—REACTANCE PER 1000 FEET OF CIRCUIT AT 133 CYCLES.

Size of Wire.	Distance from centre to centre of wires, in inches.								
	2½	3	4	6	9	12	15	18	24
0000	.26929	.28751	.31729	.35871	.40000	.429505	.452297	.470919	.500303
000	.28107	.29972	.32909	.37048	.41191	.441300	.464092	.482709	.512090
00	.29292	.31156	.34093	.38236	.42375	.453139	.475931	.494558	.523939
0	.30473	.32339	.35274	.39416	.43558	.464957	.487749	.506371	.535755
1	.31660	.33523	.36461	.40603	.44744	.476824	.499616	.518238	.547622
2	.32845	.34707	.37645	.41787	.45928	.488668	.51.460	.530082	.559466
3	.34029	.35890	.38830	.42972	.47113	.500518	.523303	.541926	.571316
4	.35213	.37076	.40014	.44156	.48296	.512351	.535144	.553768	.583149
5	.36398	.38260	.41198	.45339	.49481	.524192	.546986	.565609	.594991
6	.37581	.39443	.42382	.46523	.50666	.536038	.558826	.577449	.606836
7	.38766	.40627	.43567	.47708	.51849	.547864	.570677	.589294	.618678
8	.39950	.41813	.44751	.48892	.53034	.559723	.582512	.601136	.630521
9	.41133	.42945	.45934	.50069	.54217	.571555	.594345	.612971	.642353
10	.42319	.44182	.47120	.51268	.55403	.583413	.606203	.624826	.654211

The above formula is derived from the well-known geometrical equation of the parallelogram of forces, to wit:

$$C = \sqrt{A^2 + B^2 + 2 A B \cos a}$$

as applied to the vector diagram, Fig. 5. The relations between this

and Fig. 3 are as follows:

A corresponds to IZ;
B corresponds to E;
C corresponds to E_t;
a corresponds to $\wedge$ $\emptyset$ ϕ.

In a case, like that of Fig. 4, where the two angles are identical, their difference is zero, so that the factor cos ($\wedge$ $\emptyset$ ϕ) in the right hand term under the vinculum becomes unity, leaving the whole expression under the vinculum $E^2 + (IZ)^2 + 2EIZ$, which reduces to $(E + IZ)^2$, the square root of which, of course, is $E + IZ$; so that for such a case $V = E + IZ - E = IZ$, as an inspection of the diagram shows. As cases in which the two angles coincide form a woful minority in actual practice, the writer confesses his inability to discover any advantage derivable from line impedance tables or charts or factors.

Paris-Berlin Telephone Line.

One of the most interesting pieces of telephone work now being carried out in Europe is the new line between Paris and Berlin, which it is hoped to have ready by the opening of the Paris Exposition. France is constructing the line as far as her eastern frontier, and Germany assumes all the expenses for work within her own territory. It is said that the French expenses run about $150,000. The general route will be about 1100 kilometers or 683 miles, and will include Paris, Chalons-sur-Marne, Verdun, Metz, Frankfort on the Main and Berlin. To meet the necessities of a large number of manufacturers and merchants in Alsace, and particularly at Belfort and Mulhouse, branch lines will loop in those important centres of commerce. As to charges, France and Germany are each divided into two zones. The toll payable to each government for a conversation of three minutes will be 2 francs or 40 cents, for the first zone and 80 cents for the second. Thus for a conversation between Paris, in the first Fench zone, and Berlin, which will be in the second German zone, the total cost will be 6 francs or $1.20. In case of urgent messages, giving an immediate use of the line, the charges will be tripled, but will in no case exceed 15 francs or $3 for one complete conversation. On the other hand, there will be reduced rates of 25 cents and 50 cents for communications between towns adjacent to the frontiers or zone lines. The general bases and regulations of the arrangement are said to be similar to those which have been put in force on the Paris-Brussels telephone line and that between Paris and Geneva.

CURRENT NEWS AND NOTES.

MR. B. A. BEHREND has declined the offer of a chair of electrical engineering at Stuttgart, newly founded by that city.

THE SOUTHERN INDEPENDENT TELEPHONE ASSOCIATION will hold its third annual convention at the Peabody Hotel, Memphis, Tenn., on Feb. 28.

A MUNICIPAL ELECTRICAL SUPPLY HOUSE.—Our Canadian correspondent informs us that the town council of Barrie, Ont., has decided to carry a full line of electrical supplies for sale to the general public.

A CORRECTION.—In the article printed in our issue of Dec. 2 on "Electricity in Japan," Mr. Mayedo, of the Tokyo Electric Company, was thanked for information furnished, whereas the acknowledgment should have been to Mr. Mayeda, of the Nippon Electric Company.

THE ARC LAMP QUESTION IN DETROIT.—A gentleman in the electrical trade in Detroit, Mich., writes us to the effect that the statement recently published in the *Free Press,* of that city, that organized labor had demanded that the city replace the enclosed arc street lamps with the old-style open arcs is erroneous. The truth of the report is denied by the electrical engineer of the Lighting Commission and by the secretary of the local labor union.

CANADIAN ELECTRICAL ASSOCIATION.—The Canadian Electrical Association will hold its next annual convention in Ottawa on June 27, 28 and 29 next. The city will be brilliantly illuminated on the occasion, and elaborate preparations for the annual banquet will be made. A communication was received from the president of the International Electrical Congress extending an invitation to the Canadian Association to send a delegate to the convention to be held in Paris next August.

THE PAN-AMERICAN EXPOSITION.—It is announced that the electrical department of the Pan-American Exposition will utilize Niagara Falls power at a pressure of 10,000 volts. The power will be conducted to the transformer house and there stepped down to 2200 volts, and then distributed to 200 transformer pits located in the various parts of the grounds. The power will be distributed from the pits through subsidiary conduits to the place of use. The voltage for lighting will be 104 and for power purposes the pressure will be 208 volts.

A NEW PATENT COURT.—A bill has been introduced in Congress providing for the abolition of the existing United States Circuit Courts of Appeals and the erection of a High Court of Patents, Trademarks and Copyrights, which shall consist of a Chief Justice and six associate justices, and sit at Washington. One of the abuses at which the bill is aimed is that arising from the different interpretations of the same principles in different districts. For example, during the incandescent lamp litigation the Edison patent was sustained in some districts and declared invalid in others.

THE PELTON ENGINEERING COMPANY, of Cleveland, will make an interesting experiment in the near future with a slow-speed steam turbine for direct-connection to an electric generator. For some months past the company has been experimenting with a new turbine designed to run at a speed of 800 to 1000 r. p. m. and still hold its efficiency. Experiments have shown, it is stated, that this turbine will give any required horse-power on two-thirds of the steam required in an ordinary steam engine to produce an equivalent power. The company proposes to abandon the present steam engine and operate its entire plant with the new device. Eventually a new company will be organized to manufacture the turbine.

CIRCUIT BREAKER FOR PARALLEL OPERATION OF GENERATORS.—A patent was issued Feb. 13 to E. M. Hewlett on a circuit breaker for use in generating stations where direct-current dynamos are operated in parallel. With present arrangements of circuit breakers it may happen that on an overload one machine will take more current than another, which may cause the circuit breaker of the former generator to open, thus throwing the entire load on the other machine. This is particularly apt to occur in electric railway power stations, when the fluctuations are sudden and violent. The circuit breaker patented has for its object to throw off, when it opens, part of the load on the station by opening one or more feeder circuits, thus protecting the generator against undue strain and preventing the shutting down of the station by the opening of all the generator circuit breakers. When a circuit breaker of this type opens, it closes another circuit containing a battery and one or more circuit breakers on feeders. In the case of a sudden overload, when the generator circuit is opened the auxiliary circuit containing the batteries is closed, which causes the feeder circuit breaker to open. The auxiliary circuit breaker also includes an attachment whereby after the feeder is cut out, the auxiliary circuit containing the battery is also opened.

MICROPHONIC TRANSMITTER.—A patent was issued Feb 13 to G. F. Dupont, of Paris, France, on a microphonic transmitter adapted to work with high pressure currents. The transmitter consists of two circular disks of carbon facing each other. A ring is arranged around the disks and the space between is subdivided by thin strips of mica into a number of cells, which cells are filled with granulated carbon heated and baked at a very high temperature. The microphone is thus divided into a number of small similar microphones between the two disks. The disks are provided with protuberances on their opposing faces; they are made of carbon baked and heated to 3500 deg. Cent., and are electrically covered with metal on their outer or inactive surfaces, which metal is so deposited as to penetrate into the carbon of the disks and reduce to a minimum their resistances. One of the disks is secured to the ring above referred to, the other being movable on its axis and secured to a rigid aluminum four-arm cross. To these arms are attached four small spiral springs, the other ends of the springs being attached to extensions from the fixed disk. To maintain a perfect state of dryness of the air surrounding the granulated carbon, a simple desiccating tube is enclosed in the microphone case. The vibrating member is attached to the movable disk.

THE NEW GERMAN-AMERICAN CABLE.—It is stated that the new cable to be laid between the United States and Germany will be constructed by an English syndicate. It is thought that the cable will be laid and communication between the two countries effected in about a year.

PROJECT TO DAM THE OTTAWA RIVER.—It is stated on good authority that the proposition to dam the Ottawa River from Tetreauville, on the Quebec side of the river, to the opposite side, will be carried out this season. A company, in which prominent shareholders of the Electric Company of Ottawa are interested, is acting in the matter, and work on the structure will be commenced in the spring. The proposed dam will develop over 30,000-hp, which will be used in generating electricity for industrial establishments of Ottawa and Hull.

WIRE TABLES.—The Washburn & Moen Company has issued in pamphlet form a series of tables, compiled by Mr. Arthur G. Warren, on the sizes, weights and lengths of copper, iron, steel and aluminum round wires. The tables cover wire from .001 inch in diameter to 1 inch by regular increments to 1-64 inch. The data are also given for all sizes or the B. & S., Birmingham, British and Washburn & Moen gauges. The diameters are expressed in decimal parts of an inch and in millimeters; the sections in square inches, a log of which is given, and in circular mils. The weights in pounds per feet are given for copper, iron and steel and aluminum wire.

TELEPHONE LINES IN THE EAST.—General A. W. Greely, Chief Signal Officer, United States Army, said last week that the energies of his department are at present being directed toward the establishment of a thorough telegraph and telephone system in the Philippines to meet the constantly growing demand for such service, incident to the military operations in the islands. The lack of a mail system in the Philippines allows only telegraphic or telephonic communications, and at present over 100 telegraphic and 150 telephonic operators are established in the Island of Luzon. But as the capture and occupation of each town creates a demand for a means of communication, there is an ever-increasing need for instruments, operators and other equipment.

SIR W. VAN HORNE.—The career of Sir William Van Horne, chairman of the Board of Directors of the Canadian Pacific Railroad, is an example of the rise by sheer force of ability from a minor position to one of the highest in the management of railways. He was born in Will County, Ill., and started as a telegraph operator on the Illinois Central Railroad in 1856. He filled the positions of ticket agent, train despatcher and division superintendent, and in 1880 was general superintendent of the Chicago, Milwaukee & St. Paul Railroad. Two years later he was called to the Canadian Pacific as general manager. In 1884 he was made vice-president, and in 1888 became president of the Canadian Pacific. This was followed by his elevation to the chairmanship of the Board of Directors. In recognition of his notable services in the development of the Canadian Pacific he was knighted.

WIRELESS TELEGRAPHY IN THE FRENCH NAVY.—At the January meeting of the French Société Francaise de Physique, Lieut. Tissot gave an account of naval experiments on wireless telegraph. Ducretet apparatus was used, and signals were sent over distances up to 24 miles. The experiments showed that good results can be obtained with an ordinary induction coil, and that it is absolutely necessary to establish connection with the earth at both ends. It was found useless to supply an aerial wire with capacity at its upper end, and it appeared that there is no simple relation between the length of the aerial wire and the distance apart of stations. The coherer should not be too sensitive, the best results having been obtained with tubes of mean sensitiveness, as measured by the Branly method. To avoid disturbances from atmospheric electricity it is advisable to connect the aerial wire with earth through an induction coil, the secondary of which is in the coherer circuit.

SHALL STEAMSHIPS WINK?—Capt. F. M. Howes, of the Merchants' & Miners' Transportation Company, Baltimore, has addressed a letter to the supervising inspector-general of steam vessels on the subject of the "electric wink" as a signal for the use of steamships meeting at sea. Capt. Howes lays stress upon the fact that the whistle signal is insufficient, often causing confusion, and moreover can frequently be heard but a short distance. His plan is to have steamships provided with electric masthead lights, and he expresses the belief that by switching these on and off it would be possible to wink a signal to an approaching steamship of intention to pass to starboard or by two winks to indicate intention to pass to port. He has used "wink" signals on his ship for two years past in meeting other ships of the Merchants' & Miners' line, and he is positive that there would be ample time for the exchange of signals before any danger of collision would exist.

GAS-ELECTRIC ENGINEERS.—Our gas contemporary, *Progressive Age,* apparently recognizes the growing supremacy of electric illumination in a suggestion that gas engineers shall add electrical engineering to their professional accomplishments. It advises "technical gas men to study the operation of electric plants," and adds that "if electrical engineers are wise they will study up the gas business." Any one, it says, who has thought about this matter or observed general tendencies will have seen the handwriting upon the wall. "Both gas and electricity are gravitating into the niches for which they are best fitted, and, when they fill them properly, are giving satisfaction. Where they are waging a war of competition it is but a question of a short time before one absorbs the other." Apparently in fear that the reader might think that electricity is the "one" and gas the "other," it limits the fitness of the former to "trolley roads, small motors, or lighting in series, places prohibiting much ventilation or in dangerous atmospheres." Our contemporary thus implies that the 15,000,000 incandescent lamps used annually in lighting in parallel are misapplied.

THE EDITOR AND HIS CRITIC.—We clip the following from our esteemed London contemporary, *Lightning*: "When the secretary of the Metropolitan opened his *Lightning* on Thursday morning last, he seems to have been seriously disturbed in mind at the account I gave of the Marylebone tea party; for he hastened to send me a telegram which goes almost of itself into the dialect of my friend Mr. Dooley: 'I wish f'r to see yez,' says he 'about yere misleadin' remar-rks in to-day's issue,' says he, 'which are *intoirely* misleadin', says he. 'Plase wire an appintmint f'r me to pull the nose av ye,' says he. I did not receive the telegram, it being my custom to keep the fifth day of the week holiday, but in the evening at the Institution I was informed of its purport, and duly appointed 2 p. m. on Monday for the ceremony. I found Mr. Cunliffe Owen more pained than angry. He did not wish it to get about on so widely read and generally accurate an authority that they were still in difficulties, as seemed to be implied. I answered that the most I implied was that for all I knew to the contrary there might be further troubles." From the remainder of the note, which continues in a humorous strain, it appears that the critic was treated with much courtesy instead of being submitted to the "ceremony" jocularly suggested.

ALTERNATING-CURRENT WATT-HOUR METER.—In a patent issued Feb. 13 to G. A. Scheeffer an alternating-current watt-hour meter is described, which does not require for its operation a rotating field and obviates errors from changes in frequency. In the place of an armature in the form of a cylinder as usually employed, a thin disk of aluminum is used. The meter is so adjusted initially that its armature will rotate at a slightly faster speed than that corresponding to a current flowing through it at the lowest frequency to which the system may be submitted. This initial adjustment is provided for by a mounting for the coils and core which permits of their adjustment transversely to the axis of rotation in order to vary the amount of magnetic flux through the armature. A magnetic by-path is provided which may be adjusted to reduce the number of lines of force that would otherwise thread the armature. By means of this by-path or magnetic shunt, a certain proportion of the lines of force follow the path provided thereby, the proportion increasing with the frequency. Thus with more frequent armature reactions, the strength of the armature is reduced; the turning effort is governed by the strength of these armature reactions which vary in accordance with the frequencies. To accomplish this result the magnetic axis of the component magnetizing forces are caused to pass through the disk longitudinally to this axis of rotation, thus not creating a rotating field for the operation of the meter. Another feature of the invention enables the reactions to be adjusted between the fields created by the shunt winding and the eddy currents due to these fields, whereby a perfect adjustment of the torque of the armature to overcome friction, etc., may be effected.

FRENCH COLONIAL CABLES.—The French government proposes to lay four new submarine cables to several of its colonies. One is to run from Oran, Algeria, touching Tangier and Teneriffe, to St. Louis, Senegambia. The second cable is to run from Uahue, Tonquin, to a point north of Hong Kong. A third cable is to connect Tamatave, Madagascar, with Reunion Island, and the fourth line will be between Benin, in Upper Guinea, and the Congo possessions.

CABLE MESSAGES IN ENGLAND.—A special cable from London Feb. 15 says: In the House of Commons to-day the government was asked if the Liverpool and Manchester cotton merchants had drawn its attention to the serious delays incident to business communications between England and the United States. These delays, it was explained to the government, occurred after business hours in England, but during business hours in New York, and were due to the refusal of the postal authorities to allow the cable companies to telephone direct to their clients the messages received during these hours. Mr. Hanbury, the Financial Secretary of the Treasury, in reply, stated that the Postmaster-General was not aware that the present system was the occasion of any loss to the merchants or delay in the delivery of the messages. However, the matter would receive further consideration and an effort made to remedy the trouble.

TELEPHONE TELEGRAPH.—In a patent issued Feb. 13 to A. Sinding-Larsen, of Fredeiksvaern, Norway, a combined telephone and telegraph system is described whereby in the absence of a call subscriber, the message for him may be recorded telegraphically at the receiving station. The main points of the system patented are, first, that the transmission of the telegraph message does not influence the call-off device at the central station; second, no means are required for connecting the telegraphic recorder with the telephone system by hand; third, the telegraph system is so organized as not to interfere in any manner with the normal use of the telephone; fourth, the telegraphic recorder is so organized as to be applicable to existing telephone systems. The first and second conditions are fulfilled by using a magnet as an armature for the indicator magnet at the central, and by using the call magnet indicator at the local stations as a trasmitter for telegraphic impulses, a means being provided for transmitting telegraphic impulses of one direction only when telegraphing a message, so that the armature of the indicator magnet at the central will remain uninfluenced, thus rendering it impossible for the attendant at the central to obtain knowledge of a telegraphic message; finally, an auxiliary armature is provided for the call-bell magnet acting as a circuit closer for the telegraphic receiver circuit. When the subscriber at the receiving station is absent and the call is not answered, central places the transmitting station in connection with the receiving station for telegraphic purposes, in which case the subscriber at the station shifts a switch lever from the telephone contact to the telegraph contact. The message may then be telegraphed and will be automatically recorded at the receiving station in dots and dashes on the paper tape.

LETTERS TO THE EDITORS.

Carbon Batteries.

To the Editors of Electrical World and Engineer:

Sirs:—In your issue of Feb. 10, 1900, Mr. C. J. Reed refers to experiments with a "Short-circuited battery constructed of carbon, platinized platinum and solution of ferric chloride acidulated with hydrochloric acid, performed for the purpose of verifying with a commercial quality of carbon the oxidation obtained by Mr. Willard E. Case by the action of such a solution on the residue of burnt sugar, and described by him in a Royal Society paper."

Mr. C. J. Reed's attempted verification of my work was done, as described by himself in your issue of Aug. 12, 1899, with electric light carbon. And in your issue of Feb. 10 he refers to it as the Case cell.

In my reply to Mr. C. J. Reed in your issue, Aug. 26, 1899, I stated I never mentioned in my paper electric light carbon. The statement I made was, that ferric chloride is reduced by sugar carbonwood, charcoal and coke—and, further, that other graphitic forms of carbon will not readily, if at all, reduce ferric chloride.

The misnomer I wish to call attention to is—that Mr. C. J. Reed connects my name with a carbon cell he himself devised, which, according to his own statement, is inoperative.

AUBURN, N. Y. WILLARD E. CASE.

Motorman's Recorder.

To the Editors of Electrical World and Engineer:

Sirs:—I notice in your issue of Jan. 27, an abstract of a patent issued to me Jan. 16, for a motorman's recorder, which contains some statements not made in the patent. The patent is intended to cover broadly any device which combines an appliance whereby the maximum rate of turning on the controller is kept within a predetermined limit, with a recording device for determining the time or distance traveled with current on the motors. The value of the current has nothing to do with the action of the recording device, where as your abstract twice distinctly states that it does. Such limitation would seriously interfere with the practicability of the invention, since it would add to its complication and delicacy, and would be of no value anyway, since it can be laid down as a broad principle in ordinary electric railway operation that, the rate of acceleration being the same in all cases, the comparative amount of electrical energy required by different men operating similar cars under similar conditions will be proportional to the distance traveled or time elapsed with current in the motors; or, in other words, is dependent upon the amount of "drifting" with the current off.

CHICAGO, ILL. J. R. CRAVATH.

Induction Motors for Electric Railways.

To the Editors of Electrical World and Engineer:

Sirs:—I note in your issue for Feb. 10 an editorial entitled "Polyphase Motors for Traction," and I beg you will permit me to take issue with some of the statements it contains. The editorial begins with a statement that the prevailing impression is that the difficulties of polyphase motors for traction work are confined to the use of three conductors; to the inefficiency of the motor at all speeds except those of synchronism, and to the inductive drop caused by lagging currents. The objection is set forth that the lagging currents not only cause an inductive drop but react on the generator and pull down the voltage of the system, and that they also heat the generator armature to excessive temperatures even though it be not carrying full load. This is undoubtedly true, and until it can be overcome, it is a serious objection to polyphase motors for *street* railway work, but for interurban work, which I believe is the only traction application of the induction motor that is at present hoped for, the objection is by no means so formidable. In this class of traction the motor is either running at full speed or not at all, and the times of starting when the lagging component is most in evidence are reasonably few and far between. Moreover, there exists devices for helping out the lagging component and to minimize its effect on the main generating voltage. One of these is the condenser, and at least one manufacturer claims to make commercially reliable condensers for alternating current work.

At the transformer substation it is possible to install a condenser plant. This condenser can be made using oil as a dielectric and with glass separators. It will be very large in order to obtain a reasonable capacity, but it is very cheap to construct and at a substation there would be room for it. There may be no condenser insulation yet made which will withstand the high electromotive forces which sometimes arise from the presence of higher harmonics, but there is a dielectric which will heal itself promptly after having suffered from such electromotive forces, and that dielectric is oil.

It is possible to confine the effect of the lagging component to certain sections of the line by the use of rotary substations. If the power be distributed from the main station to synchronous motors at high frequencies and transformed to a low frequency by an inductor type of machine at the substation, the reaction due to lagging currents induced by traction motors will go no further than the substation, and the generator at that point can be built with special reference to this feature. Lagging currents are certainly an objection in a polyphase traction system, but they are not insurmountable.

The next objection set forth in the editorial is the difficulty of maintaining small clearance, and reference is made to present street railway troubles in this connection. The fact is that the present street railway has the poorest bearings of any dynamoelectric machine built, and the principal excuse for this is that there is not room for good bearings. Moreover, the slightest decentralization of the armature causes the pole piece to attract the armature against the bearings with great power and substantially shorten their life. Neither of these troubles are present to so great a degree in the polyphase motor. Such motors, as is well known, work out to large diameter and short

length along the axis of rotation. Moreover, the rotating part of the machine is usually hollow, and it is frequently necessary to mount the active iron on a hub. This arrangement permits of the use of a substantial bearing of sufficient length to keep the armature rigidly central with reference to the field. Besides, the field is a rotating one and the bearings will tend to wear much more uniformly.

Further along in the editorial may be noted the statement that with a frequency of 25 cycles a low-speed motor would have so many poles that the distribution of its wiring in a sufficient number of clots per pole would become utterly impossible. I would suggest a resort to actual figures. The available space under a car body from car floor to roadway is about 40 inches. Of this 30 inches is available for the motor, and in an induction motor of this diameter the polar bore would be about 22 inches. This will accommodate nearly 70 one-half-inch slots with a tooth of almost the same width. If we should adopt 6 poles—a by no means excessive number—and 25 cycles—a probable frequency for such work—we would have a speed of 500 revolutions per minute, one which is very common in single reduction railway work. With 70 slots there would be nearly 12 slots per pole or 4 slots per pole per phase, using the three-phase system. More slots might be desirable, but this arrangement will answer, and simply goes to show that it is perfectly possible to construct a workable polyphase single reduction motor which will meet traction requirements.

I do not wish my communication to be understood as taking unreasonable exception to any of the objections set forth in the editorial of Feb. 10. They are certainly objections which will require ingenuity to overcome, but I should be very sorry to believe that American designers cannot easily and in the near future surmount them, sufficiently at least to permit of the use of the induction motor for long distance electric traction. And I do not think it Utopian to predict that the polyphase traction motor and the electric trunk line may become mutual solutions for each other.

NEW YORK. GEORGE T. HANCHETT.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

By CARL HERING.

DYNAMOS, MOTORS AND TRANSFORMERS.

REFERENCES.

Non-Synchronous Motors.—HEUBACH.—A long theoretical article, illustrated by many diagrams, in which he continues his investigation, referred to in the Digest May 20, 27, 1899. He remarks that a non-synchronous motor can be overloaded in such a way that the slip becomes more than 100 per cent., also that an external mechanical power can give a speed above synchronism so that the slip is negative. He gives a general theory of the action of non-synchronous motor for any slip between $+\infty$ and $-\infty$, using the graphical method of Heyland for three phase motors. In the second part he discusses the action of single-phase motors graphically by means of his own diagrams.—*Elek. Zeit.*, Jan. 25, Feb. 1.

Closed Circuit Armature Windings.—RICHTER.—A very long article developing in a general algebraic form, various relations between the number of coils and the gaps or spaces in the windings, including the relations which are necessary so that a closed circuit winding, such as those of continuous current armatures not of the Gramme ring type, become possible. The article is of interest, but cannot be abstracted here, as he uses many general terms and symbols which must be defined. Among the armature windings which have been specially serviceable he mentions those of Hering, Arnoux, Fritsche, Weymouth, Arnold, Parshall and Hobart.—*Zeit. fuer Elek.*, Jan. 1, 14.

Friction of Induction Motors at No Load.—BRAUN.—A long French abstract of the German article noticed in the Digest Nov. 4.—*L'Eclairage Elec.*, Jan. 13.

Transformers.—A short illustrated description of the present standard types of British Thomson-Houston transformers.—Lond. *Elec. Eng.*, Jan. 26.

POWER.

150-Ton Electric Crane.—A very well illustrated description of a 150-ton electric crane at the imperial dock in Bremerhaven, Germany, for the installation of ships' boilers and other heavy machinery and the fitting out of war vessels. The detail of the mechanical construction is fully described. The turning mechanism is actuated by a direct-current motor of 26-hp at 550 revolutions per minute, a worm gear and spur and pinions transmitting the rotation to the mast. The two motors which operate the lifting tackle are series wound and deliver each 17½-hp at 450 revolutions. They operate upon a common spindle to which they are connected by flexible couplings. It is important for such a large crane to be adapted also for light work, the maximum load being a rare exception. The ratio of transmission between the first and second spindles can be changed within wide limits; upon these two spindles are four pairs of gears, the ratios of which are nearly as follows: 1 : 6, 1 : 3, 3 : 4, 3 : 2. Electromagnetic and mechanical brakes are used, all working automatically. The movement of the carriage is brought about by a 26-hp motor at 550 revolutions. The motors operate at 110 volts and are similar to street car motors, with ironclad fields.—*Zeit. des Ver. deut. Ing.*; translated with good illustrations in *Eng. News*, Feb. 8.

Water Power Plant.—A well illustrated description of the water power plant for the Isle of Man electric tramways. The turbines develop 140-hp at a speed of 720 rev. per minute. There is a combined bipolar dynamo and booster, the generator having an output of 160 amp. at 520 volts and the booster 160 amp. at 100 to 200 volts. The turbine plant is worked in connection with three battery substations, each containing 250 cells of the chloride type, all three stations being worked in parallel. When the cars are taking current, the turbine generator assist the batteries; but when the cars are descending the grades or standing, the generator is charging the batteries. During the night time, when the cars are not running, the booster is connected in series with the generator, and the batteries are in turn charged at a rapid rate and at a high voltage through the underground feeders; this enables a full load to be maintained continuously on the turbines. The plant has just completed a 240-hours' continuous test, during which it maintained a steady load varying from three-fourths to full load; and although the turbines are not provided with any governor, it was not once necessary to alter the regulation.—Lond. *Elec.*, Jan. 26; reprinted with one illustration in *El'ty*, Feb. 14.

Continuous Current Power Transmission.—CUENOD.—A brief abstract of a paper read before the International Society of Electricians in Paris. Power transmission schemes are to be considered from an economical and from a technical point of view. To be economical, the cost of a horse-power year should not be more than $20 to $30, and the first cost of installation not more than $200 per horse-power. He made some comparisons of the economy of direct and alternating current transmission and gave a brief outline of the work of Thury in long distance power transmission with the continuous current series system. He called attention to the fact that the efficiency of the dynamos in this system is equal to that of the best alternators, that there are no transformer and no induction phenomena in the series system. Mr. Thury followed with a description of the apparatus used in his system; the maximum voltage used by him is 12,000, but he hopes to reach 22,000 volts.—*L'Ind. Elec.*, Jan. 25; abstracted in Lond. *Elec. Eng.*, Feb. 2, where it is pointed out that it is a disadvantage of the series system that the high voltage is brought on to the consumer's premises, and also that a fault in one consumer's apparatus may cause an interruption to the supply of other motors connected in series with this consumer.

REFERENCES.

Electrically-Driven Pumps.—An illustrated description of a pump devised by Riedler and Stumpf, operated at high speed, so that it may be direct connected to an electromotor of about 300 revolutions per minute.—*Elek. Anz.*, Jan. 21.

Electricity in Mines.—An illustrated description of the electric installation of some coal mines in Bockwa. Continuous current of 500 volts is used.—*Elek. Anz.*, Jan. 11.

Price Chart.—A diagram giving the price of power from 20 to 250 kw-hours in dollars, for eight different prices per kw-hour from 25 to 8 cents. The price is assumed to be proportional to the power consumed.—*Power*, February.

TRACTION.

Continuous and Three-Phase Current for Traction.—The conclusion of the discussion of the report on the visit of the Brit. Inst. E. E. to Switzerland in September, 1899, the first part of which was referred to in the Digest Feb. 17.—Lond. *Elec., Elec. Rev., Elec. Eng.,* Feb. 2; *Lightning,* Feb. 1.—In an editorial note the chief feature of the discussion is said to have been the comparison between continuous and three-phase current for traction work. From the various opinions expressed it is concluded that a three-phase trolley line is eminently suited for traction lines on which the stopping places are few with long distances between them, and in localities where crossings and junctions are not numerous. For urban work generally, continuous currents with series motors appear best, and if three-phase transmissions is desirable, synchronous converters or motor generators are to be used. Another point of interest in the discussion was the difference of opinion between Mr. Crompton and Mr. Ferranti about three-phase switchboards. The former admired their simplicity, the latter said that the complication made him quite ill. Editorially, it is remarked that the profusion of bare metal at high pressure in the Kanderwerk and elsewhere, is somewhat surprising, but that the arrangements are by no means complicated.—Lond. *Elec.,* Feb. 2.

Electric Traction in the United Kingdom.—The large annual table published as a supplement sheet, on the progress in electric traction in the United Kingdom during 1899; also a brief editorial discussion. There is now a total of 180 lines in all stages of development, while the corresponding number in the previous sheet was 154. Of these 180 lines, 41 are in actual operation, and 28 are in progress of construction, while the remainder include 12 underground railways projected for construction in London, together with 99 projected light railways and tramways. The aggregate mileage of single track of all the lines now in operation has grown from 240 to 422 miles.—Lond. *Elec.,* Jan. 26.

Electrolysis From Return Currents.—ELLICOTT.—An illustrated article on the electrolysis problem in Chicago. The importance of the rail bonding and connecting is illustrated by a case where the drop in potential in one mile of track and supplemental copper return wire was 8½ volts, and after three bad bonds had been replaced, a drop of only 2½ volts was shown; a waterpipe paralleled the track for a considerable distance, and before the change in bonds it indicated positive to rails one volt at two places, while after the change the potential between the rails and waterpipes was about one-thirtieth of a volt at all points. As city electrician of Chicago, he recommended a clause to be inserted in an ordinance recently passed by the council, requiring the railway company to provide and maintain a return circuit of such conductivity that the maximum potential between any part of the return circuit and the waterpipes should not exceed one volt, and also providing that there should not be a variation in potential of more than one-half volt between any two points within a space of 300 feet measured along the line of the railway.—*West. Elec.,* Feb. 10.

Electric Mail Coach.—An illustrated description of a mail coach with seats for 18 persons, which proved very satisfactory in the automobile competition following the exhibition in Berlin (Digest, Dec. 9). On fair roads it can run with one charge over 47 miles at a speed of 9 miles, or over 37 miles at a speed of 16 to 19 miles. The accumulator battery consists of 80 cells, has a capacity of 300 to 320 amp.-hours if discharged in 5 hours, and weighs 6600 lbs. The coach with battery weighs 13,200 lbs. It is driven by two 7½-hp motors. With rubber tires the consumption of energy was found to be 15 to 20 per cent. higher than with iron tires; therefore iron tires were chosen.—*Elek. Anz.,* Jan. 28.

Electric Locomotives.—TISCHBEIN.—An abstract of a paper read before the Society of German Mechanical Engineers. For the working of electrically propelled locomotives over standard gauge railways, an overhead trolley system of conductors is suitable when a frequent service of cars over long or short stretches has to be provided for. But when locomotives are required principally for shunting purposes over a complicated system of points and cross-overs confined in comparatively small area, it is advantageous to increase the mobility of the locomotive, and at the same time simplify the system of overhead conductors by using an accumulator trailer car, to be attached to the locomotive, while it is shunting. For a slow service of cars over a line of considerable length, accumulator driven locomotives should be used, if there is a convenient generator station having spare power for charging. A comparison of the steam and of the electric locomotives from an economical standpoint results in favor of the latter.—Lond. *Elec. Eng.,* Feb. 2.

REFERENCES.

Storage Batteries for Power Houses.—GEBHARD.—A long illustrated French abstract of the German paper noticed in the Digest Sept. 2.—*L'Eclairage Elec.,* Jan. 13.

Electric Railway.—A description of the project of an electric railway from Vienna to Pressburg, devised by Mechtl-Steinamanger. The total length will be 62 miles; the current is to be supplied by three 250-kw generators driven by water power, giving either 500 volts direct or 300 volts alternating current from the same winding. —*Elek. Anz.,* Jan. 11, 21.

British Tramways.—ROBINSON.—An illustrated outline of the development of tramways in the United Kingdom from 1860 up to date. —*Cassier's Mag.,* February.

Dangers in the Trolley System.—SAHULKA.—A paper read before the Electrotechnical Society of Vienna, discussing the electrolytic corrosion of water and gas pipes, contact of other overhead wires with the trolley wire, and the dangers from broken wires. He suggests remedies for them all, but does not seem to advance anything new.—*Zeit. fuer Elek.,* Jan. 7 and 14.

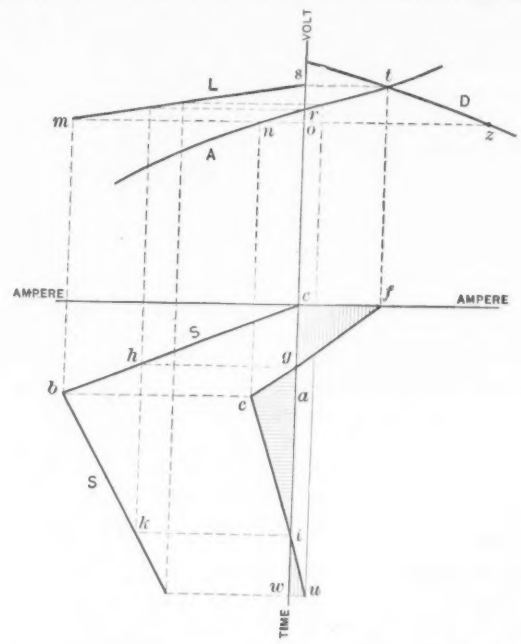
Automobiles.—A long article of general nature on the progress of automobilism in 1899.—*Ind. and Iron,* Jan. 12; *Sc. Amer. Sup.,* Feb. 3.

Automobiles.—PARKER.—A long abstract of a paper on the development of electric automobilism in England.—Lond. *Elec. Eng.,* Jan. 26.

Mountain Railroad.—A short description of the well-known road up Mount Dore in France. It is a cable railroad, the cable driving drum on the summit being operated by an electric motor. Water power is utilized and three-phase current transmitted to the summit. —*El'ty,* Feb. 14.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Action of Storage Batteries.—KOHN.—An illustrated article, describing a simple method of treating graphically the combined action of a dynamo and an accumulator battery connected in parallel. The relation between current and voltage of an accumulator is represented graphically by a characteristic curve, as it is with dynamos. In the adjoining figure *A n r t* is such curve; that part on the left of the axis of ordinates relates to the discharging, that on the right to the charging, in the following way: at the voltage *e s = f t* the battery is charged with the current *e f = s t*, at the voltage *e o* it is discharged with the current *n o*; *e r* is the e. m. f. of the battery on open circuit; the more the curve *A n r t* is inclined to the horizontal,



CURVE OF COMBINED ACTION OF DYNAMO AND ACCUMULATOR.

the greater is the resistance of the battery. The curve *D* is the characteristic curve of the dynamo. For the curve *A* and the curve *D* the abscissas represent the current of the accumulator and dynamo respectively, the ordinates the voltage at the points where the parallel connected accumulator and dynamo are connected to the line. The combined action of accumulator and dynamo is now as follows: at

the voltage *e r* the dynamo supplies current to the line, the accumulator is neither charged nor discharged; at a voltage above *e r* the dynamo supplies current to the line and charges the battery; at a voltage below *e r* both the dynamo and the accumulator supply current to the line. If now in the diagram for any voltage *e o* a line parallel to the horizontal is drawn, cutting the curves *A* and *D* in *n* and *z*, *n o* is the current supplied to the line by the accumulator, *o z* is the current supplied to the line by the dynamo, hence *n z* is the whole current fed into the line. It appears that for any voltage, if the respective parallel is drawn to the horizontal, that part between the curves *A* and *D* is the current fed into the line by the combined action of accumulator and dynamo. This part is now plotted parallel to the horizontal from the axis of ordinates to the left, for instance, *m o* is made equal to *n z*. The "resulting characteristic" curve *L*, obtained in this way gives the current fed into the line for any voltage. If a variable load is given, represented by a certain varying current required in the line for a given interval of time, it may be represented graphically in the lower half of the adjoining diagram; the axis of ordinates *e g i* represents the time, the current required in the line for each moment is plotted as abscissa to the left, then the curve *S*, thus obtained, represents the load in the line, plotted in the figure in the form of two straight lines *e b k*. It is now easy to determine the separate action of dynamo and accumulator in supplying this load. At the beginning of the time, the current required in the line is zero and the dynamo charges the accumulator with the current $e\ f = s\ t$. At the time *e g* the current required in the line is *h g* and is furnished wholly by the dynamo, the accumulator being neither charged nor discharged. At the time *e a* the current in the line is $a\ b = m\ v = m\ p + n\ o$, the part *m n* being furnished by the dynamo, the part $n\ o = c\ a$ by the accumulator, etc. The curve *f g c i u*, obtained in this way, then represents the current which is absorbed or furnished by the accumulator, the parts *f g* and *i u* representing the condition of charging, the parts *g c* and *c i* the condition of discharging. Hence the shaded surfaces represent the ampere hours, those to the right, the ampere hours given to the accumulator by the dynamo, and that to the left, the ampere hours given by the accumulator to the line. He applies this method to show that if both these parts, namely, the ampere hours received and those given out by the accufulator, are in the proper proportion for a certain case, this proportion will be very greatly altered by a small variation in the voltage of either dynamo or accumulator, all other things remaining the same; also that the resistance of a battery has a great influence upon its action. Finally he shows how to predetermine an accumulator battery, if the load in the line and the characteristic curve of the dynamo are given.—*Elek. Zeit.*, Jan. 25.

Lighting Plant.—A well illustrated description of the electric lighting system of Bromley and Chiselhurst, in England. In the town of Bromley itself there is a fairly compact load, but large residential districts lie removed by distances from one to three miles from the centre of the town, and there is also the village of Chiselhurst, 2¾ miles distant, scattered around three points of maximum density. A 2 × 210 volt three-wire continuous current system is used, the station being situated in the very centre of the Bromley load. At Chiselhurst there is a substation to which power is transmitted from Bromley by continuous current at 2000 volts. There it is converted by variable ratio continuous current converters down to 420 volts, the converters being supplemented by a storage battery of 230 cells with a capacity of 650 amp.-hours at 80 amp. and capable of discharging at 120 amp. without injury. The armatures of the variable ratio converters are wound as follows: the high pressure armature winding extends over a shorter distance than the low pressure winding, the latter being wound over the former, and there being a second core for the prolonged part of the low pressure winding; there are two auxiliary poles, diverted from the main field and covering the low pressure, but not the high pressure armature; these poles have supplementary windings, in series with which a rheostat is connected; by adjusting this resistance, the relative number of lines of force passing through the two armatures is varied, and thus the transformation ratio is also varied.—Lond. *Elec.*, Jan. 26. (See in detail E. W. & E., Feb. 17.)

Stockport.—An illustrated description of this English municipal plant which has a lamp connection equivalent to 7700 lamps at 8-cp, including 36 arc lamps for public lighting. A 2 × 230-volt three-wire system is used. There are five direct-driven dynamos, two of 140-kw each, three of 56-kw each. There are also two sets of 133 chloride accumulators of 750 amp.-hours capacity and designed for a maximum discharge current of 400 amp.—Lond. *Elec.*, Jan. 26.

Govan.—A well illustrated description of the municipal lighting plant of Govan, which is a part of Greater Glasgow. Current is furnished for an equivalent of 10,000 lamps of 8-cp. The three-wire continuous current system with 250 volts on each side is used. The station contains two dynamos, a motor-generator for balancing purposes, a motor-driven booster and a battery of Tudor cells.—Lond. *Elec.*, Feb. 2.

Ventnor.—An illustrated description of the lighting plant at Ventnor, Isle of Wight. A 2 × 210-volt three-wire system is used. There are two 84-kw dynamos, giving 180 amperes at 410 to 440 volts, a combined booster and balancer set, and an accumulator battery of 220 cells, with a capacity of 480 hours at 55 amp. discharge, and capable of discharging at 80 amp. without injury. Current is supplied to an equivalent of 3730 lamps of 8-cp, exclusive of 16 open arc lamps of 10 amp, and 65 incandescent lamps of 25-cp now being erected.—Lond. *Elec.*, Feb. 2.

Electricity in Agriculture.—An article discussing in a general way the advantages of the use of electricity for lighting and power purposes in the country, and describing briefly some electric installations on German farms.—*Elek. Anz.*, Jan. 28.

Automatic Pressure Regulator.—DICK.—An illustrated description of a regulator devised by him. The action is based upon the rising and falling of a solid iron cylinder, the lower part of which is enclosed in an insulating cover and plunges into mercury contained in a contact case, while the upper part is in the inside of a solenoid. The contact case contains contact plates, separated by insulating micanite plates, the former being connected to the different points of a field regulating resistance; the movements of the iron cylinder therefore cut these resistances in and out of circuit. There are three forces acting upon the iron cylinder; the magnetic attraction of the solenoid upon the iron core, the mechanical force tending to make the iron core float upon the mercury, and the total weight of the core; the third can be adjusted by a special mechanical device at the upper end of the iron core. The theory of the instrument is given and some applications are discussed.—*Elek. Zeit.*, Jan. 25.

REFERENCES.

Designing of Electric Generating Stations.—ROBERTS.—A paper read before the British Society of Architects and discussing the matter from the point of view of an architect. Great importance is laid on the choice of a site, both in the interests of the architect and of the engineer; a situation in residential neighborhood involves many complaints, as to alleged vibrations, noise, smoke, condensed steam, etc. He discusses the design and construction of the buildings and makes recommendations concerning the various departments.—Lond. *Elec., Elec. Eng.*, Feb. 2; the paper is commented upon very favorably in some editorial notes in the Lond. *Elec.*, Feb. 2.

Light and Power Installation.—SCHINDLER.—An illustrated description of the electrical installation of the Bibliographical Institute in Leipzig, a large German publishing house. There are 1500 incandescent lamps, 23 arc lamps and 10 motors from 1 to 16-hp. Continuous current at 110 volts is used.—*Elek. Anz.*, Jan. 18.

Leicester.—A well illustrated description of this English municipal plant, equipped entirely with the inductor type of alternator, as referred to in the Digest Nov. 11.—Lond. *Elec. Rev.*, Jan. 26.

Isolated Plant.—An illustrated description of the light and power plant in the glass block department store of Donaldson & Co., in Minneapolis. There are three 75-kw 110-volt machines.—*West. Elec.*, Feb. 10.

WIRES, WIRING AND CONDUITS.

Variation of Potential and Current Along Long Distance Alternating Current Lines.—BREISIG.—A long well illustrated paper read before the Electrotechnical Society of Berlin. Steinmetz and Pupin have treated this subject analytically starting from the differential equations for a line element; in comparison with these, the present method is of special interest, as he starts with simple empirical data. He shows that the e. m. f. and also the current, at the terminals of the line can be represented as linear functions of both the e. m. f. and the current at the generator end of the line. The linear relation is correct as long as there is no iron in the line. This relation can therefore be represented by two equations with four constants. If the condition is introduced that the line is symmetrical with respect to its centre, there remain only two independent constants in both equations. He shows that they can be found easily by experiment, by measuring the impedance of the line when the terminal of the line is insulated, and when it is grounded. In this way for a line symmetrical with respect to its centre, the e. m. f. at the generator end can

be determined from the e. m. f. and current at the receiving end. He then introduces the condition that the whole line is homogeneous and shows how to find the e. m. f. and current at any point of the line, without further calculation by the following argument: if there are two homogeneous lines, of equal properties per unit of length, but of different length, and both lines feed into identical receiving circuits, the e. m. fs. and currents at the generator ends of both lines may be chosen so that the e. m. fs. and currents at the terminals are equal; then that point of the longer line which is at a distance from the farther terminal, equal to the length of the shorter line, has exactly the same e. m. f. and current as the generator end of the shorter line; in this way the e. m. f. and current can be found for any point of the line. He applies his formulas to a graphical representation of the question and treats the cases of a line insulated at the terminal, or grounded at the terminal, or feeding into a receiving circuit of given impedance. He concludes that as his method is empirical, all the factors which enter are properly considered. Although the formulas seem somewhat complicated, he claims that they are simple for practical purposes and that all calculations can be made with the slide rule.—*Elek. Zeit.*, Jan. 25.

Electric Wiring of Buildings.—CHAMEN.—A long abstract of a paper read before the Institution of Engineers and Shipbuilders in Glasgow, giving a review of the present practice of house wiring and a discussion of the advantages and disadvantages of the following systems; india rubber insulated wires in wood casing; the different forms of lead-covered cables, either consisting simply of lead tubes into which india rubber covered wires are drawn; or of wires insulated with paper of fibre or india rubber, the lead sheathing drawn tightly over the insulation, each wire having its own insulation and lead sheathing; or the same method except that two insulated wires have one lead covering drawn over the pair; or the same method, except that the two conductors are concentric and usually that the outer conductor is not insulated at all from the lead sheathing; the several variations of india rubber covered wires in iron tubing either ordinary iron gas barrel with screwed joints and cast-iron junction boxes, or ordinary unwelded sheet-iron tubes or skelps with cast-iron junction boxes fitted with sockets, the joints, however, not being screwed or fixed in any way; or welded iron tubes lined with some insulating material, having joint boxes, bends, and fittings similarly lined throughout. The drawbacks of wood casing are said to be that it is extremely unsatisfactory in damp places, that it affords no mechanical protection against nails, etc., that two distinct classes of tradesmen are required for its fitting up, and that it lends itself very readily to the protection and hiding up of bad work. To prevent the danger of an arc between lead or iron tubing and a gas pipe, either electric conductors should not be laid near gas pipes at all or the sheathing should be connected in a thoroughly substantial manner with a water pipe, preferably at some point in the lower part of the building. The metal sheathed systems, more especially the iron sheathed one, are said to possess great advantages over wood casing. He regrets that but little has been done in the way of standardizing cast-iron fuse and junction boxes and bends and connections, etc., for use with wrought-iron gas barrel, and that the workmen are not provided with simple tools for rounding out the edges of tubes after cutting them off; "if some one would display some enterprise, after the manner of our American cousins, a most complete, safe and satisfactory system of iron tubing could be introduced, which at the same time would not be too expensive for general use." He has long hoped for the introduction of a concentric system of conductors, in which the outer sheathing is of wrought iron tube, which contains built up as an integral part of it, the two conductors with their insulation, the whole of the tube being filled up solid; the difficulty of pointing with such a system would be much reduced if the outer conductor could be uninsulated, as the iron tube itself might then be used as a return conductor, leaving only the one wire to be jointed and insulated. He discusses the tree system, the mains being thick first, getting thinner and thinner as each branch leaves them; it is complicated on account of the fuses. This objection is obviated in the distribution board system; it is extremely desirable to have no buching at all, although there are admittedly cases where some compromise within safe limits must be allowed; a convenient safe limit may be set at two wires, only when of opposite polarity and in iron or other suitable metal tubing, and four wires only when of the same polarity, either in metal tubing or in wood casing; in each instance the circuits not to carry more than 3 amp. each at 250 volts. For some cases a "common sense compromise" between the tree and the distribution board system is recommended.—The paper is commented upon in an editorial. While it is agreed that there are methods of wiring far preferable to wood casing, the fact remains that excellent wiring can be done with wood casing, and that in some instances the practice still offers advantages over others, e. g., for "disguised" surface work in ordinary dry rooms. For this purpose twin lead-covered wire also frequently lends itself admirably, and surface work is to be encouraged wherever permissible.—Lond. *Elec.*, Feb. 2.

Concentric Cables.—STERN.—A short illustrated description of an automatic device, similar to a lightning arrester, by which the current can pass from an external conductor of a concentric cable to the earth, if the potential difference exceeds a certain value for an instant. The device consists of a pair of toothed plates made of a non-arcing metal separated by an air gap. This is in series with the fuse wire and when the current becomes too strong, the fuse which connects one of the plates with the earth, in melting, releases a lever which in falling short circuits the air gap by making a connection like in a knife switch, with the other plate. The device is in practical use since 1895, and is said to have proved satisfactory.—*Zeit. fuer Elek.*, Jan. 14.

ELECTRO-PHYSICS AND MAGNETISM.

Radioactivity Produced in Substances by the Action of Thorium Compounds.—RUTHERFORD.—A very long account of an experimental investigation. All thorium compounds examined produce radioactivity in substances in their neighborhood, if the bodies are all uncharged. With charged conductors the radioactivity is produced on the negatively charged body. In strong electric fields the radioactivity can be concentrated on the surface of thin wires. Thorium oxide is the most active of the thorium compounds in causing radioactivity, but loses its power if it is heated for several hours at a high temperature. The power of producing radioactivity is closely connected with the presence of the "emanation" from thorium compounds, and is in some way dependent upon it. The radiation excited in bodies is homogeneous, and of a more penetrating character than the radiations from thorium or uranium. The radiation is confined to the surface of the substance, and is independent of whether the substance is a conductor or non-conductor and of the nature of its surface. The intensity of the radiation emitted falls off in a geometrical progression with the time, decreasing to half its value in about 11 hours. The decay of intensity is independent of the state of concentration of the radioactivity or the nature of the substance. The amount of induced radioactivity increases at first nearly proportional to the time of exposure, but soon tends to a value when the intensity of the radiation varies very little with increase of the time of exposure. The amount induced in a given time on a conductor depends on the potential-difference between the electrodes, and tends to a constant value for large e. m. fs. The amount of radioactivity is independent of the pressure of the gas, except at low pressures when the amount on the negatively charged conductor decreases with the pressure. The amount is not much affected whether the gas is hydrogen, air or carbonic acid. No increase of weight has been observed by making a body radioactive. The radiation from a platinum wire is not altered much by placing the wire in a flame, hot or cold water, or nitric acid. Hydrochloric and sulphuric acids rapidly remove the radioactivity from its surface. The solution, when evaporated, leaves the active portion behind. A general explanation of all these results is given by the assumption that the radioactivity is due to a deposition of particles of a radioactive material emitted by thorium compounds. But this theory involves difficulties, which are pointed out.—*Phil. Mag.*, February.

Half-Ring Electromagnet.—DUBOIS.—A description of a ring electromagnet yielding a field of some 40,000 units over a space of several millimeters. By using micromagnetic appliances with dimensions of the order of 0.1 mm., the values 51,600 for H, and 74,200 for B were obtained. But as this apparatus weighs 560 lbs. and uses 5-kw, he has constructed a lighter type by reducing the linear dimensions 20 per cent. and cutting off the lower third of the ring, replacing it by a bedplate. Excitation is produced by eight magnetizing coils; the power consumed is 1.44-kw. A still smaller type is also described. The efficiency of these half-ring electromagnets is, if anything, greater than that of the whole ring instrument, the field furnished by the heavier type being 36,000 units, and by the lighter type 20,000 units.—*Zeit. fuer Instrumentenkunde*, December; abstracted in Lond. *Elec.*, Feb. 3.

Dielectric Constant.—HASENOEHRL.—A short note on a paper on the dielectric coefficients of liquid nitrous oxide and oxygen. He obtained 1.465 for boiling oxygen, which is in close agreement with

Dewar and Fleming, and with the value calculated from the Clausius-Mosotti formula.—Lond. *Elec.*, Jan. 26.

REFERENCES.

Hittorf's Dark Space.—EBERT.—An illustrated French abstract of the German paper noticed in the Digest Nov. 4.—*L'Eclairage Elec.*, Jan. 13.

Cathode and Canal Rays.—BERY.—An illustrated French abstract of the German paper noticed in the Digest Sept. 16.—*L'Eclairage Elec.*, Jan. 13.

Canal Rays.—EWERS.—A long illustrated French abstract of the German paper noticed in the Digest Nov. 4.—*L'Eclairage Elec.*, Jan. 13.

High Frequency Glow Light Phenomenon.—EBERT.—An illustrated French abstract of the German paper noticed in the Digest Nov. 18.—*L'Eclairage Elec.*, Jan. 13.

Theory of Earth's Magnetism.—Some editorial comments upon Prof. Rowland's theory (Digest, Jan. 20). Further particulars are awaited and attention is called to an apparently similar theory worked out by Prof. Schuster, who believed the assumption that every large rotating mass is a magnet, to be a reliable theory of the earth's magnetism.—Lond. *Elec.*, Feb. 2.

ELECTRO-CHEMISTRY AND BATTERIES.

Sterilization of Water by Ozone.—A full record of the very extended discussion which followed the paper of Weyl (Digest, Dec. 2). The great services which sand filtration has done, were pointed out, especially by Lindley, who doubted whether even in the event that treatment with ozone could do all that has been claimed for it, it could replace sand filters. He thinks it would rather be in the nature of a supplement to them, by removing the large amount of suspended organic matters by sand filtrations and applying the ozone process to the effluent, when it would have a better chance to work upon the remaining bacteria and kill them; the ozone process should not be used all the time, but only when an unusual danger is at hand. —*Jour. fuer Gasbel u. Wasservers.*, Nov. 25, Dec. 2; a very long abstract in *Eng. News*, Feb. 8.

REFERENCES.

Accumulator Tests.—Two articles on the competitive tests of the automobile club of France. In the first, by Blondin, the arrangement and the results of tests are described, as noticed in the Digest Feb. 10. The second, by Bainville, gives the first part of an illustrated description of the various accumulators which took part in the tests. The following are described: the accumulator which corresponds to the chloride accumulator in this country, the positive plate is of the Planté type and is formed by the superposition of a large number of corrugated bands of lead, held together by two lead rods; the negative plate is of the usual chloride type; the Pollak, the Tudor and the Pescetto accumulators which were previously described in the Digest.—*L'Eclairage Elec.*, Jan. 13, 27.

Dry Accumulator.—KIESERITZKY.—An article on the "dry" accumulator, manufactured by the Watt Accumulator Co. He calls attention to the advantages of dry batteries for traction purposes and claims that in the Watt accumulator the disadvantages of other dry accumulators are obviated. The composition of the dry material, in which the plates are embedded, is not given. The accumulator is said to have proved satisfactory on the accumulator cars between Berlin and Charlottenburg.—*Elec. Tech.*, Jan. 15.

Electrolytic Production of Hpyochlorites.—SIEVERTS.—An article in which he gives the results of experiments made to investigate the influence of current density upon the formation of hypochlorites. The fact that electrolytically produced bleaching solutions have a higher bleaching action than ordinary solutions of chloride of calcium with the same quantity of chlorine, was found to be due to the existence of free hypochlorous acid.—*Zeit. fuer Elektrochemie*, Jan. 4, 11.

Decomposition of Chloride of Sodium.—LORENZ and WEHRLIN.—The first part of an investigation of the electrolytic formation of hypochlorites and chlorates. They describe experiments with a circulating solution of chloride of sodium in a special apparatus, which is illustrated.—*Zeit. fuer Elektrochemie*, Jan. 25.

Transport Numbers.—DITTENBERGER and DEITZ.—An account of measurements of the transport numbers of dichloride of platinum and perchlorite of tin.—*Wied. Ann.*, Vol. 68, p. 853; abstracted in *Zeit. fuer Elektrochemie*, Jan. 11.

Ionization Heat.—HOLLARD.—The conclusion of the English translation of the article noticed in the Digest Feb. 10.—Lond. *Elec. Eng.*, Jan. 26.

Electrochemical Laboratory.—LORENZ.—A well illustrated description of the electrochemical laboratory of the Technical High School in Zuerich (see also Digest, Feb. 3).—*Zeit. fuer Elektrochemie*, Jan. 4.

UNITS, MEASUREMENTS AND INSTRUMENTS.

New Application of Price's Guard Wire in Insulation Tests.—AYRTON and MATHER.—A brief abstract of a Brit. Phys. Soc. paper. While for insulation tests made by the direct deflection method, the guard wire properly applied affords complete protection against surface leakage when the ends of the cable tested are near the galvanometer, a difficulty arises when the ends of the cable are at a considerable distance from the testing instrument; this may render air insulation impossible. They have overcome this difficulty by applying a guard wire along the entire length of the lead, which is accomplished by using a concentric cable to connect the cable under test with the galvanometer, the inner wire being used as the lead and the outer as the guard wire. The principle can also be applied to determine whether a defective piece of cable is bad throughout or has one or more isolated faults. In this case the cable is placed in two water tanks, one of which is earthed, and the other fairly well insulated. By a suitable arrangement of the guard wire, the resistance of the cable in the earthed tank is then determined, so that by altering the length of this part the character of the insulation can be determined throughout the whole length of the cable. In the discussion which followed, Campbell said that the necessity of having a concentric cable could be obviated by simply hanging the lead from the guard wire by short lengths of materials of fair insulation.—Lond. *Elec., Elec. Eng., Ind. and Iron*, Feb. 2.

Photographic Current Curves.—SEEFEHLNER.—The first two parts of a long article describing a method, in which Braun's cathode tube is used (in the same way as by Zenneck, Digest, Feb. 10). If the cathode beam is acted upon by the crossed fields of two alternating currents and the curve form of one of them is known, that of the other can be found from the curve of the spot of light on the fluorescent screen; if, for instance, the known curve consists of straight lines, starting from zero to a maximum value and decreasing through zero to an equal minimum value and so on, and if the zero values of this curve and of the curve under test differ by a quarter of a period, then the curve of the spot of light is the desired one. The current curve of straight lines produced by a device with a rotating ring and connections as in the Wheatstone bridge, the current being supplied from a continuous current source. Some of the photographic curves obtained are reproduced.—*Zeit. fuer Elek.*, Jan. 1, 7.

Fault Test for Braided and Other Cable Core.—APPLEYARD.—An abstract of a British Physical Society paper describing a method of finding the fault without removing the braiding or tape. The core is wound on two insulated drums, the intermediate piece of cable being about 10 feet long. One end of the core is left free, the other is connected to earth through a galvanometer and a battery. A guard wire is connected from some point between the galvanometer and the battery to some point of the braiding on the wire between the drums. A wet cloth connected to an earth wire is laid on one or other of the drums, over the braiding and the galvanometer deflection noted. The earth wire is then changed over to the second drum and the corresponding deflection is observed. A comparison of these deflections at once indicates upon which drum the fault lies. With the galvanometer still deflected, the core may be run through a suitable contact brush or sponge attached to the guard wire. The instant the fault passes under the guard wire contact the deflection falls and the fault is located. The galvanometer is then short-circuited through the fault and thus completely protected.—Lond. *Elec., Elec. Eng., Ind. and Iron*, Feb. 2.

Potentiometer.—LEEDS.—An illustrated description of a proposed new simple form of potentiometer. The feature is the method of subdividing the potentiometer resistance. There are 15 resistances of 1000 ohm each in series with 10 of 10 ohm each. Any one of the 1000 ohm resistances can be shunted by a series of 9 resistances, each of 1000 ohm. Any one of the 10 ohm resistances can be shunted by a series of 9 resistances, each of 10 ohm. Then if the difference of potential between the terminals of the whole set of resistances is 1.4999 volts, the drop of potential for each of the 15 resistances of 1000 ohm (except the one which is shunted) is 0.1 volt, for each of the 9 resistances of 1000 ohm 0.01 volt, for each of 10 resistances of 10

ohm (except the one which is shunted) 0.001 volt, for each of 9 resistances of 10 ohm 0.0001 volt, so that any voltage from 0.0001 to 1.4999 can be read by steps of .0001 volt. He finds that the probable error in the measured e. m. f. will be about 1-18 of 1 per cent. There are therefore no inherent difficulties in adjusting the apparatus so as to give results to a satisfactory degree of accuracy. The complete scheme of the potentiometer connections and a plan of the instrument are also given.—*Biddle's Bull.*, January.

REFERENCES.

Compensation Apparatus.—BRUGER.—An illustrated description of a compensation apparatus manufactured by Hartmann and Braun. By a combination of several sliding rheostats of special construction the manipulations are simplified, enabling the result to be read directly. The application of the apparatus for measuring high and low voltages is described.—*Phys. Zeit.*, Jan. 6.

O'Keenan Meter.—O'KEENAN.—The full illustrated paper read before the Int. Soc. of Elec., in Paris, describing this meter, noticed in the Digest Dec. 9, 30.—*Bull. de la Soc. Int. des Elec.*, November.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Telephone System for Party Lines.—WEST.—A well illustrated description of the system invented by him and to be introduced very shortly into the German public telephone system. Up to five subscribers can be connected to a "central apparatus," which is connected to the exchange by one common party line. The central apparatus, containing seven accumulators, may be located in any suitable place, preferably beside the telephone of any one of the subscribers. As soon as one of the subscribers takes his telephone from the hook, all the other subscribers' stations on the same line are immediately locked; and similarly when the exchange rings up one of the subscribers, all the stations on the line are locked at once, and immediately afterwards by means of the central apparatus the one station which is to be rung up is unlocked and its bell inserted in the circuit. The electromagnetic device for locking and unlocking is described and illustrated. When the exchange calls one of the subscribers, it sends, according to his number on the line, one, two, three, four or five short impulses of current passing through the electromagnet of the central apparatus which then automatically unlocks the apparatus of the party wanted. The central apparatus is also described in detail and illustrated.—Lond. *Elec.*, Feb. 2.

REFERENCES.

Germany.—An article giving statistical data on the telegraphy and telephony in Germany for 1898, including Bavaria and Wurtemberg.—*Elek. Zeit.*, Jan. 25.

Double Circuit Telephone Switchboard.—A brief description with a diagram, of the Siemens & Halske system.—*Elec. Rund.*, Jan. 15.

Wireless Telegraphy.—DELANY.—A popular outline of the development of wireless telegraphy.—*Eng. Mag.*, February.

Relay for Wireless Telegraphy.—GREARINI-FORESIO.—A translation of an illustrated paper read before the Belgium Electric Association, in which he describes his repeater noticed in the Digest Oct. 21 and Dec. 2.—*El'ty*, Feb. 14.

Railway Signals.—BRIERLEY.—An illustrated communication giving some further details of his signaling system (Digest, Jan. 27).—Lond. *Elec. Rev.*, Jan. 26.

Block Systems.—KREJSA.—The first part of an illustrated outline of Boda's theory of the electric block systems for railways, based upon the practice of Siemens & Halske.—*Zeit. fuer Elek.*, Jan. 7, 14.

MISCELLANEOUS.

Copper in 1899.—KERSHAW.—A short article on the copper market and copper mining finance in 1899. The price rose up to $385 per ton in April, and fell gradually since that time to $350 in December. During 1899 in London 13 new copper mining companies were registered with an aggregate capitalization of $18,250,000. It is probable that the majority of these new companies are overcapitalized, and when the price of copper has dropped back to its normal level of $250 per ton, some of the newly opened mines will cease production, but for the present they are likely to have considerable influence upon the market.—Lond. *Elec. Rev.*, Feb. 2.

REFERENCES.

Electric Fish.—GOTCH.—A reprint of the paper noticed in the Digest Jan. 13.—*Elec. Rev.*, Feb. 7.

Animal Electricity.—HEDLEY.—A reprint of the article noticed in the Digest Oct. 21.—*Sc. Amer. Sup.*, Feb. 3.

Stassano Process.—MANN.—An illustrated article on this process, described in the Digest Sept. 30, Oct. 28, Nov. 11.—*Sc. Amer.*, Feb. 3.

Electric Mishaps.—Brief description of some electrical fires, taken from the reports of Mr. Merrill, of the Electric Bureau of the National Board of Fire Underwriters.—*West. Elec.*, Feb. 3.

New Books.

ELECTRICAL TESTING FOR TELEGRAPH ENGINEERS. By J. Elton Young. New York: The D. Van Nostrand Company. 264 pages, 89 diagrams. Price, $4.00.

This book is written for submarine cable engineers, and Mr. Young has had considerable experience in the subject of which he writes.

There are twelve chapters and ten appendices. Eight chapters are devoted to regular tests and four to localizations of faults. The chapters on the measurement of insulation and capacity are particularly good. The book is carefully written by a man who thoroughly understands his subject, and contains many practical lessons with no unnecessary mathematics. It will prove a valuable adjunct to the cable engineer's library.

BOOK RECEIVED.

PROBLEMES SUR L'ELECTRICITE. Recueil Gradué Comprenant Toutes Les Parties de la Science Electrique. Par Robert Weber. Paris: Ch. Beranger. 413 pages, 34 illustrations. 6 francs.

Directory of Electrical Societies, Etc.

NORTHWESTERN ELECTRICAL ASSOCIATION. Next meeting, Waupaca, Wis., July, 1900.

NEW YORK ELECTRICAL SOCIETY. Next meeting, March 2. Lecture: "Copper from the Ore to the Wire Bar," by A. R. Ledoux.

CHICAGO ELECTRICAL ASSOCIATION. Next meeting, March 2. Paper: "Recent Pfogress in the Feld of Electrochemistry," by H. R. Kingman.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS, New York. Next meeting, Feb. 28. Paper: "Notes on Electric Traction Under Steam Railway Conditions," by Edward C. Boynton.

CANADIAN ELECTRICAL ASSOCIATION. Next meeting, Ottawa, Ont., June 27, 28 and 29.

SOUTHERN INDEPENDENT TELEPHONE ASSOCIATION. Next meeting, Memphis, Tenn., Feb. 28, 1900.

New "Wood" Focusing Series Arc Lamp.

At the present day open arc lighting—the earliest branch of electric lighting—would appear to admit of little improvement, particularly in the details of lamp mechanism. Nevertheless a new open arc lamp now being placed on the market by the Fort Wayne Electric Works and the invention of Mr. J. J. Wood, shows that with respect to focusing arc lamps there was considerable room for improvement.

The principal object in view in designing the new lamp was to make the focusing mechanism entirely distinct from, and independent of, the feeding mechanism, thus enabling any good single-carbon gravity feed lamp to be simply transformed into a focusing lamp. The carbon guides used in other lamps are abandoned, thus avoiding heavy shadows and reduction of effective candle-power.

Figs. 1 and 2 show the lamp and mechanism as they appear with the carbons consumed, and ready for trimming. It will be seen that the lower frame and carbon holders are almost identical with those of an ordinary non-focusing lamp.

Fig. 3 illustrates the lamp as it appears when installed for use, and suspended from one of the new Fort Wayne cut-outs. The lamp is exceedingly short and ornamental in appearance. The case is designed to be not only weatherproof but well ventilated, and yet thoroughly protect the mechanism, which is not exposed during the act of trimming the lamp. The switch for turning the lamp on and off is located conveniently at the top where it is easily manipulated, and by reference to Fig. 1 it will be seen that a portion of the case slides up out of the way while the globe is being lowered, making the carbon holders easily accessible for trimming.

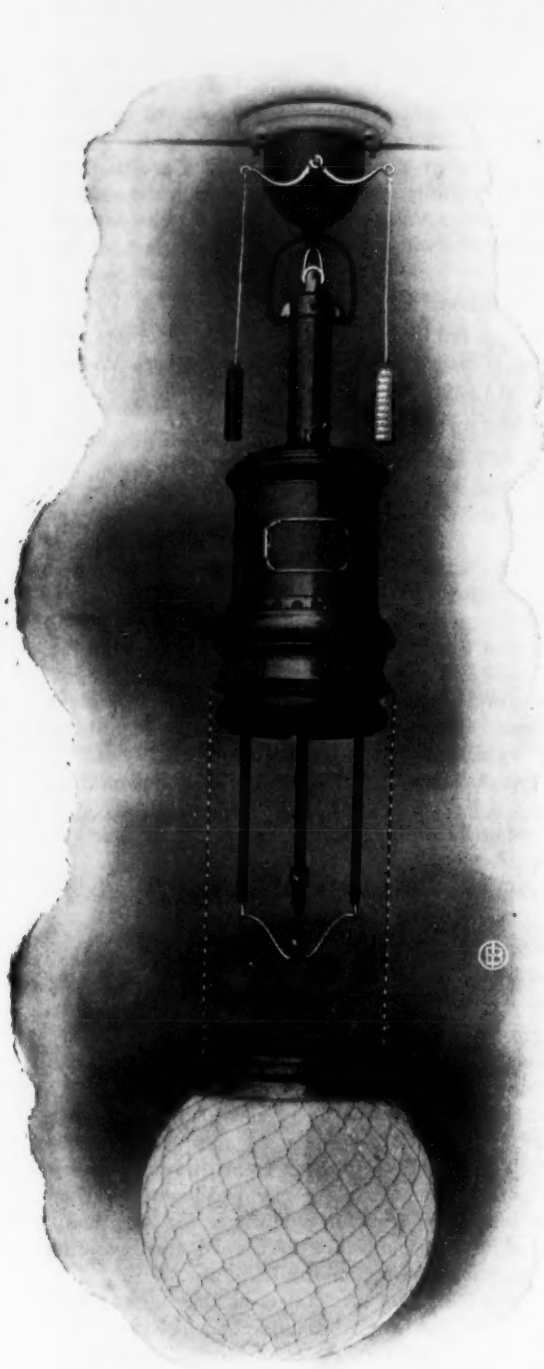
The positive carbon holder, though composed of but two pieces, yet allows the carbons to be placed in perfect alignment and rigidly held there with the least possible difficulty. The feeding mechanism of the lamp, clearly shown in Fig. 4, is of the direct-acting shunt-feed type, and will feed the carbons without readjustment on any direct-

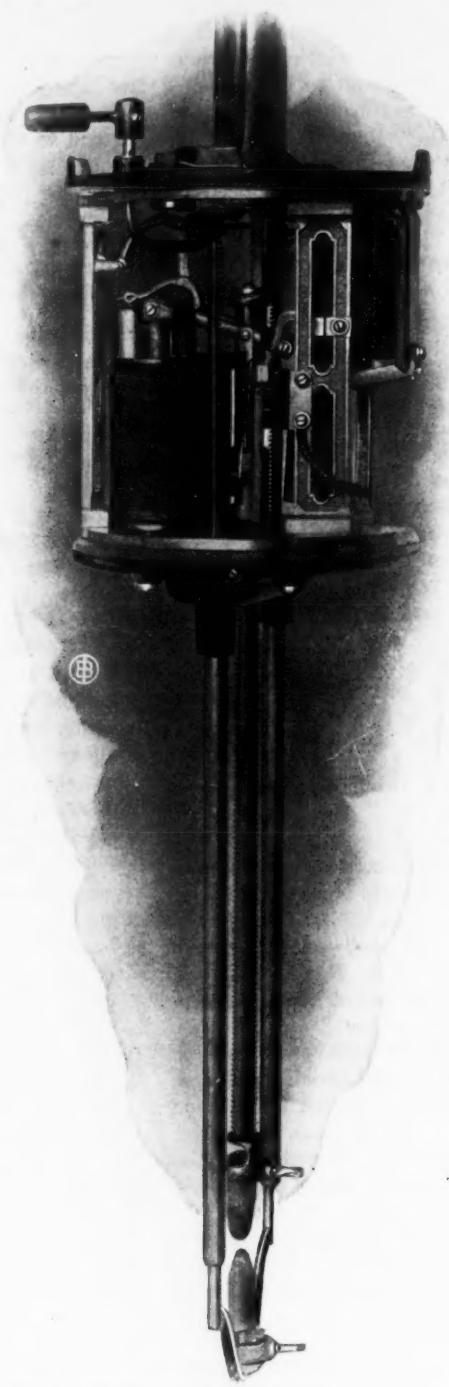
current series circuit of from 6.5 to 9.6 amperes. The carbons are separated instantly to a full feeding arc by a small magnet of special construction in the main circuit, which acts directly on the carbon rods without the intervention of springs or other devices. As a result of this arrangement the energy required by this magnet to perform its functions is reduced to from 3 to 6.5 watts, depending on the candle-power.

The shunt or feeding magnets are so proportioned as to be capable of moving the armature through its entire range with a maximum variation of but 3 volts; and as this range includes not only the feeding point, but also the point at which the lamp cuts out, it will be seen that the lamp must always feed and cut out within 3 volts of what it is adjusted for. The armature of the latter and its magnet spring are so proportioned that as it is attracted into the magnets the power required diminishes in almost the same proportion as the power of the magnet is diminished, due to the shortening of the arc; as a consequence the feeding of the carbon is hardly perceptible with a voltmeter. The adjustment of the arc is accomplished by turning a small thumb-nut, which tightens or loosens a spring carefully protected from mechanical injury.

The clutch for feeding the carbons is of an entirely new design, and known as a five-point clutch. This clutch is self-cleaning and will not stick, and affords extra large surfaces for wear. It is mounted in such a manner that the weight of the feed rod is always borne by the magnets, and the point at which the clutch releases can be adjusted by raising or lowering the stop with which the clutch lever comes in contact.

Another feature noticeable in the mechanism is the absence of the cut-out magnet so common to most lamps. The cut-out mechanism used is a decided departure from the old methods heretofore employed, and is constructed with a double set of contacts, which are brought together one set in advance of the other by the combined action of the feeding and separating magnets. The first set of these contacts is faced with coin silver, and enables the lamp always to cut-out at the same voltage. They short circuit the main or separating magnet, allowing it to drop its armature, thereby closing the second set or large contacts, and finally cutting out the lamp. This action jars the mechanism and has a strong tendency to force the carbons together and cause the lamp to relight. As the first set of contacts cannot open until the final set is closed, the operation of the cut-out is sparkless. In addition to the foregoing there is an auxiliary cut-out which automatically short-circuits the whole lamp when the carbons are consumed, thereby saving the energy absorbed in the mechanism.





FIGS. 1 AND 2.—ARC LAMP AND MECHANISM, WITH CARBONS CONSUMED.

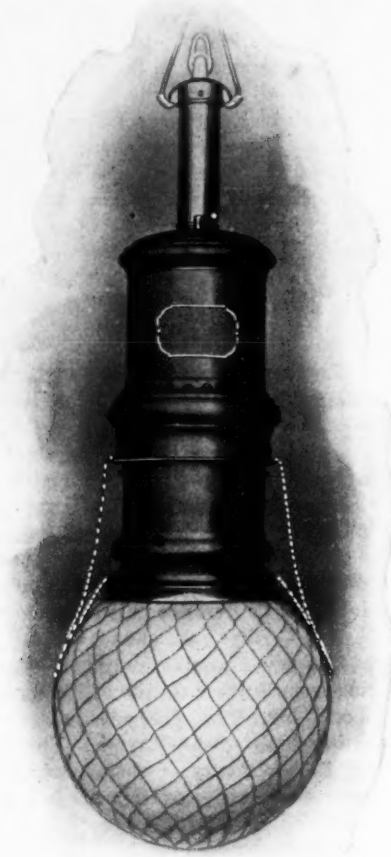


FIG. 3.—LAMP READY FOR USE.

Fig. 4 clearly illustrates the new focusing mechanism, which, as before stated, is entirely independent of the feeding mechanism of the lamp, and can be removed for examination as a whole.

The positive carbon is carried by the centre rod, while the negative carbon is carried by the lower cross-bar, which is connected to the two side rods, but not insulated. These rods are connected together by shafts and pinions, as shown, which are proportioned so as to cause them to move at the proper ratio. It will be seen that there can be no chance of the mechanism sticking, as the whole system is

symmetrical and balanced. The weight of the centre rod acts through the pinions, which engage a rack on each side, thus revolving the shaft and the small pinions so as to lift both ends of the negative carbon carrier with the same velocity, and thereby preventing any possible tendency to bind as would be the case were it lifted from but one side only. This mechanism is fastened to the lower plate of the lamp case on the under side and thoroughly insulated from it. It

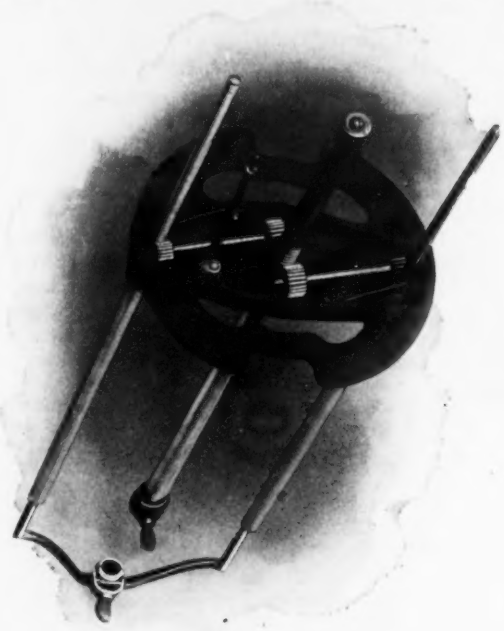
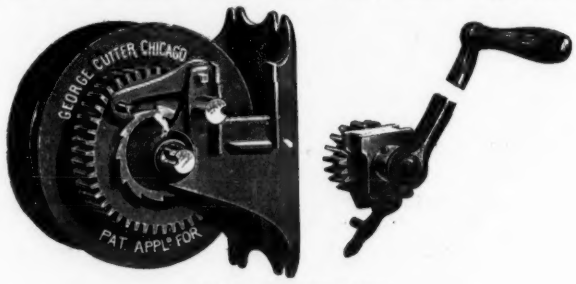


FIG. 4.—FOCUSING MECHANISM.

is easily removable should it be necessary, while at the same time it will be seen that the pinions, etc., are protected from dust or injury. The current is carried to the feed rods by contact springs edge on, which method is not only self-cleaning, but makes a perfect contact at all times, thus preventing the rods from pitting. As a result the failure of the lamp to feed, and the labor and wear of cleaning are reduced to a minimum.

Cutter's Improved Arc Light Windlass.

The growing tendency towards using either flexible wire rope or a rather small braided cotton rope makes it necessary to use a good windlass at the pole opposite each lamp, and if this windlass is geared, the extra leverage thus gained will make the trimmer's work easier. Mr. George Cutter brought out a windlass several years ago with the pinion built as a part of the handle carried by the trimmer. It has now been improved by some little changes suggested by the



IMPROVED WINDLASS.

experience of users. Thus the boss at the end of the shaft is made round, so that it cannot be turned by means of an ordinary wrench. The same is true of the simple but positive lock which is operated by the same handle. The "pinion handle" itself has the metal parts made of malleable iron so as to be light, and as this handle also fits the main shaft, the trimmer can use the device as a plain windlass for quick lowering or for raising light lamps. The improved form is now being placed on the market by the George Cutter Company, of Chicago.

A New Flush Switch.

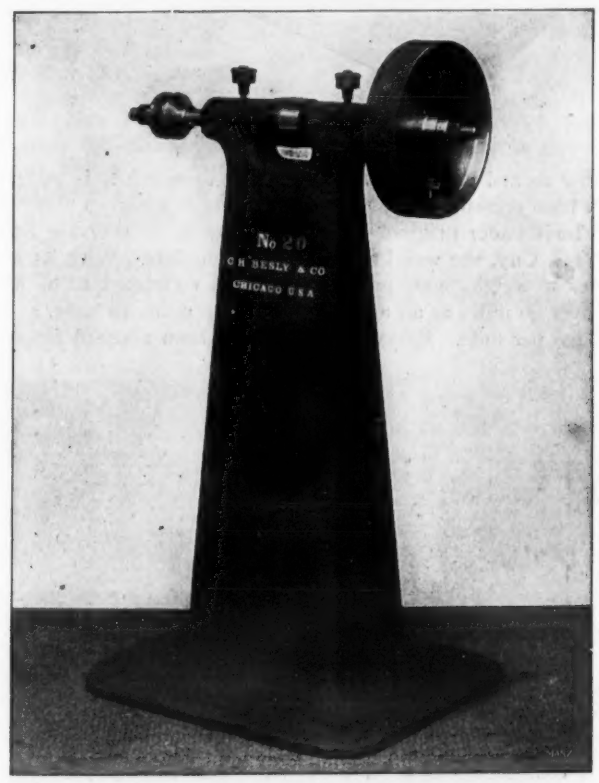
A new idea in switch construction is shown in the accompanying illustration, which represents a flush switch now being placed upon the market by Mr. W. T. Pringle, 112 North Twelfth Street, Philadelphia, Pa. The unique feature of this switch is that it is operated by a lever instead of push buttons, it being a knife blade switch, pure and simple. As will be seen from the illustration, the mechanism is operated by raising or lowering the lever, through a slot in the face-plate. When the lever is up the switch is in the "off" position, and when it is down the current is on, the usual "off" and "on" indications being unnecessary. The lever is powerful and the motion smooth

NEW FORM OF FLUSH SWITCH.

and easy, a spring effecting a quick make and break contact. The mechanism is contained in a brass crib which relieves the porcelain from all strain. These switches fit the standard switch receptacle.

Band Grinder.

The band grinding machine shown in the accompanying illustration, and made by Charles H. Besly & Co., 10 North Canal Street, Chicago, is intended to take the place and do the work of a large



BAND GRINDER.

number of polishing wheels. On the spindle is mounted a cast-iron wheel, on the periphery of which an elastic surface is produced by a felt covering. Emery or other abrasive material in the form of a piece of emery cloth, is tightened firmly to this surface. To change the grade of emery it is merely necessary to remove the binding and replace it with another, an operation requiring only about a minute. This machine is particularly suitable for shops where skilled polish-

ers are not employed. The makers state that an ordinary shop-boy, with little practice, would on it do the work of a skilled polisher.

The First American Electric Ambulance.

When one considers that the first and fundamental object of a hospital is to lessen suffering and death, it would seem desirable to release the horse from ambulance service. Not a few writers in describing the scenes on a battlefield depict the sufferings of the wounded horses as far more terrible to witness than those of the wounded soldiers. Any one who has seen an ambulance go to "the front" in a city in any great emergency of disaster, must have pitied the horses as they were driven pitilessly onward, through the deep snows of winter or the fierce heats of summer. The strain on the horses in such humane service is, indeed, most inhumane, and one of the first applications of the modern automobile has been made in the attempt to mitigate such evils. New York has to-day the first electric automobile ambulance in the country, herewith illustrated.

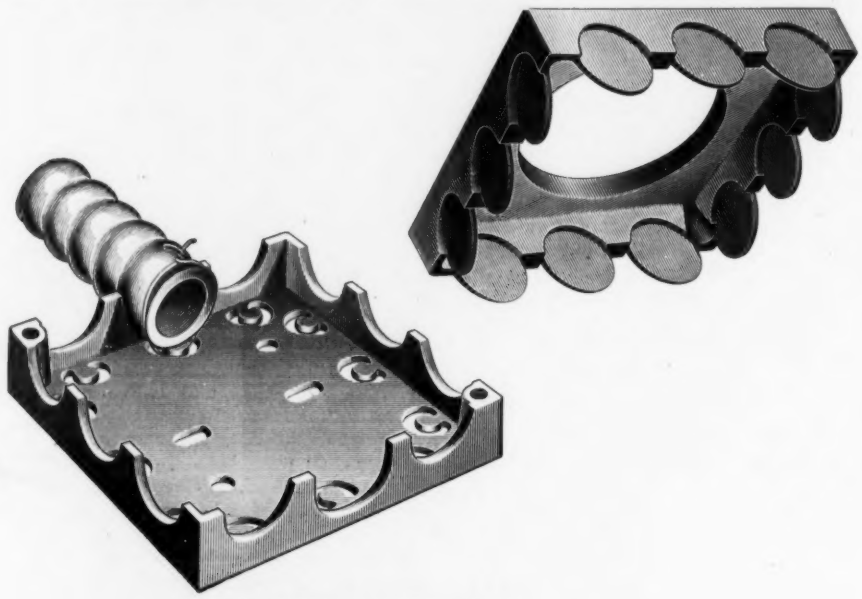


FIG. 1.—PARTS OF JUNCTION BOX.

It is now owned by St. Vincent Hospital, to which it is understood to have been presented by Mr. Edward Kelly at a cost of about $3000. It was built under original specifications by F. R. Wood & Sons, of New York City, the well-known carriage builders. With its storage batteries it weighs 4000 pounds, and it is estimated to be able to make over 40 miles at an average speed of 9 miles an hour, at a cost of 2 cents per mile. Every precaution has been adopted for smooth

ELECTRIC AMBULANCE.

and easy running. A rawhide pinion is used, and the tires are of solid rubber. The 44 cells of battery are grouped in four sets, and in addition to the current supplied to the motor, three lamps are lit. By means of plate glass windows in the front and sides, and glass doors at the rear, the ambulance can be entirely enclosed. The windows are of the disappearing type, and the doors are removable, so that the ambulance will answer the demands of both summer and winter.

A successful trial of the ambulance was made last week when it ran between St. Vincent's Hospital and Bellevue Hospital at a rate of over 12 miles an hour, in charge of Dr. Farrell, of St. Vincent's. The results obtained are very satisfactory to the authorities, and further advances in this line are expected, with immense benefit to both man and beast.

New Interior Conduit Fittings.

In the wiring of buildings for electrical illumination, transmission of power, etc., there are many conditions that necessitate the use of individual junction boxes constructed especially for such emergencies. A device of this character adapted to all purposes is a "Universal Junction Box," just brought out by the Sprague Electric Company,

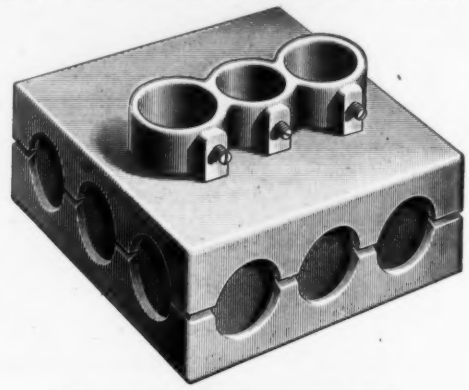


FIG. 2.—JUNCTION BOX COMPLETE.

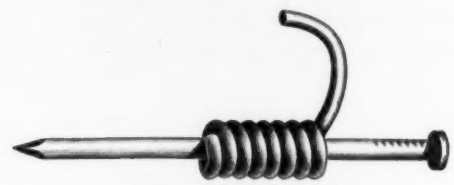


FIG. 3.—"PIPE HOOK."

and shown in Figs. 1 and 2. This box is so constructed that one, two or more inleading conduits may be put in place by knocking out one or more tongues, making the requisite openings in the box. The bottom of the box has perforations permitting a wire to be inserted to tie the conduit in place while the work is in progress. This is an important feature, and saves much time and expense.

These boxes may be applied either to ceiling or wall wherever a gaspipe passes through without the use of ceiling or wall blocks, or other means of attachment now ordinarily used. The ceiling box shown in Fig. 2 can be secured to the gaspipe by a set-screw.

Fig. 3 illustrates a new type of "Pipe Hook" made by the same company, and has the advantage of being secured to the wall or ceiling by a screw or nail, without the danger of being broken by a false blow. In fact, it would be impossible to break it in such a manner.

Fig. 4 shows the new lead bushing and expanding tool the Sprague Electric Company is now making. The bushing has a thread cast on

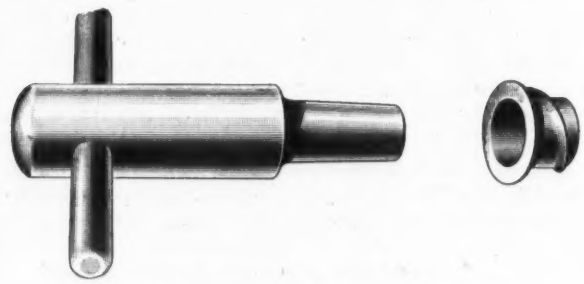


FIG. 4.—LEAD BUSHING AND EXPANDING TOOL.

the outside, and it can be screwed into the end of the pipe and then expanded by inserting the expanding tool and giving it a few short twists to the right and left, never turning it completely around.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET was chiefly noteworthy for its general decline in active speculation and for the remarkable developments in the New York Third Avenue debt situation. Prices are strong, as a rule, and the trunk railroad figures could hardly be improved, but the market is slow and a trifle shy. It is a remarkable thing that with the iron and steel industrials making a splendid showing in net and in dividends, their quotations remain far below the average held by other lines of securities which have apparently little but age to recommend them. During the week, on sales of 6810 shares, Western Union gained 1½ to 84½. General Electric, on 1425 shares, was firm around 127½. Metropolitan Street Railway eased off 1¾ to 176¼ on dealings in 18,680 shares; Manhattan Elevated, on 45,016 shares, gained ¾ to 98, and Third Avenue, on 106,620 shares, went off again 3½ to 96¾. In Boston, American Bell Telephone closed at 338; Erie rose 3 to 110½; Mexican, 2¾-3; Michigan, 97-101; New England, 135-140; Boston Elevated was quoted at 122; West End, 93; Massachusetts Electric Railways, common, 28, preferred, 78½. In Chicago, Metropolitan Elevated 4s were quoted at 95¾, preferred, 81½; West Chicago Railway, 110¾; Shelby Steel Tube, common, 20. In Philadelphia, Electric Storage Battery was quoted at 94½-95 common, 96-97 preferred; Pennsylvania Electric Vehicle, common, 7-7⅛, preferred 3½-3⅝; General Electric Automobile, 4-4⅛; Philadelphia Traction, 98¼; Union Traction, 37¼; American Railways, 3¾; Philadelphia Electric, 5½-5⅝; Electric Company of America, 13½. In the New York outside market, Consolidated Electric Lighting and Equipment closed at 13½-15; Electric Boat, common, 15-17, preferred, 35; Electric Vehicle, common, 40-50, preferred, 90; Illinois Electric Vehicle Transportation, 2-2½; New York, 8½-9¼; New England, 6-6½; General Carriage, 6¾-7; St. Louis Street Railway, common, 27, preferred, 80; Otis Elevator, common, 21-25; preferred, 85-88.

THIRD AVENUE AFFAIRS.—The desperate situation of the Third Avenue Railway still continues a leading topic of financial discussion, especially as Kuhn, Loeb & Co. have withdrawn from the proposed syndicate which was to fund the $17,000,000 debt. Some developments are looked for this week. A member of the syndicate is reported as saying that the sum required to finance the company would exceed $30,000,000, made up as follows: Loans from bank, $17,000,000; due to contractors and supply people, $5,000,000; money necessary to complete power house, $3,000,000; money necessary to exchange equipment in underlying properties, $5,000,000. The company nevertheless declared a quarterly dividend of 1 per cent. last week. Much of the company's misfortune is attributed to the way in which it has been mulcted and milked by the politicians.

BUFFALO BELL TELEPHONE.—At a special meeting of the stockholders of the Buffalo Bell Telephone Company last week it was voted to increase the capital stock from $2,000,000 to $5,000,000. It is understood that a part of this increase will soon be offered to the stockholders for subscription at par, and that the balance will be sold in the same way from time to time as funds are needed for new construction. An additional story is to be constructed on the Seneca street building, and a contract has been awarded to the Western Electric Company, of New York, to reequip the entire Buffalo service. In Rochester the company has nearly finished a fine fireproof office building. In Niagara Falls its office building and subways are approaching completion. Large extensions will be made to the toll line system.

GENERAL CARRIAGE.—General Carriage stock was somewhat stronger on reported progress in commencing active operations. The company has leased the property at 116 West Fiftieth street and 66 West Forty-third street, New York, for use as carriage houses, where the active part of the company's business is to be transacted. The company announces that twenty cabs will be in operation Saturday, with eighty to be delivered in the next few weeks. The company talks of making its own vehicles, but so far, it is said, has only bought electrics from the Woods Company.

NEW YORK EDISON.—The stockholders of the Edison Electric Illuminating Company, which is now controlled by the New York Gas & Electric Light, Heat & Power Company, which is itself owned by the Consolidated Gas Company, have elected the following directors for one year: Hugh J. Grant, N. F. Brady, Thomas E. Murray, Louis B. Gawtry, R. A. Carter, Alfred B. Thatcher, William H. Bailey, Henry J. Hemmens, John W. Lieb, Jr., James S. Connell, Henry Morgenthau, Frank Enos and Michael F. Phelan.

CHICAGO ELEVATED DIVIDEND.—The directors of the Metropolitan West Side Elevated, Chicago, have declared a dividend on the preferred stock of 2½ per cent. for the year 1899. The dividend is payable February 28. This is the first stock dividend the road has declared. It can be stated authoritatively that the company will pay at least 4 per cent. on its stock this year. In July a regular semi-annual dividend of not less than 2 per cent., it is said, will be declared.

WESTERN UNION BONDS.—The directors of the Western Union Telegraph Company have made arrangements with Kuhn, Loeb & Co. for marketing the new issue of bonds; $5,701,000 of the bonds will be used for the retirement of previous issues. Of the old bonds $4,920,000 are 7 per cent. debentures, maturing on May 1 next, and $781,000 are 6 per cent. debentures maturing March 1 next. There are also $1,153,000 real estate 7 per cent. bonds which mature about two years hence.

Commercial Intelligence.

THE WEEK IN TRADE has been excellent, with a large run of business in every department, and with a better outlook even than before. In fact, each new event as it looms up seems to put this country in a stronger position. We have just seen the declaration in Congress for sound money, but while that means much, the balance of foreign trade was shown again by the January returns to work in our favor, and the increase in imports is but a sign of larger purchasing power. It cannot be said that the manufacturing districts evince any weakness, but now the south is coming to the front with 9-cent cotton and a tremendous demand for the product, so that the reports from Dixie are most cheerful. Reports of 56 railroads to Bradstreet's for the first week in February show an aggregate of earnings of $7,884,233, a gain of 15.2 per cent. over the same period in 1899. For the calendar year 1899 125 roads report gross earnings of $1,183,283,445 and net receipts of $391,612,519, gains of respectively 10.7 and 12.9 per cent. The heaviest gains in gross are those made by the coal roads, 14.8 per cent., while the largest net gains are by the southwestern roads, 24.5 per cent. Bank clearings for the week, one holiday included, aggregate $1,507,131,336, a decrease of 16.5 per cent. from those of the preceding week, but a gain of 8.7 per cent. over a year ago, of 69 per cent. over 1897, of 118 per cent. over 1894 and of 8 per cent. over 1892. Outside of New York there is a falling off of 10 per cent. in clearings from those of last week, but compared with a year ago there is a gain of 13 per cent. shown. Failures for the week number 199, as compared with 231 last week, 160 in this week a year ago, 269 in 1898, 325 in 1897 and 276 in 1896. In the metal market copper has sold off to 16 cents, but is in large demand, steel rails are firm at $35 per ton, and tin is quoted at 30 cents, a rise of ¼ cent.

WORK IN NORTH CAROLINA.—A large amount of work is being done at Winston-Salem, N. C., by the Fries Manufacturing & Power Company, of which Mr. H. E. Fries is president. This locality, which is a great tobacco district, was one of the first to have an electric railway on the old Sprague system, and some time ago a 1000-hp Stanley 2-phase plant was also put in. The Fries Company now owns all the electrical applications in sight and is spending large sums of money in rebuilding and additions. Mr. F. A. Barr is in charge of the plant, and the contractors are J. G. White & Co., of New York. The street railway is being considerably extended, and four new Brill cars have been bought, while seven and one-half miles of 70-pound steel rails are being laid. To the power plant a Stanley 3-phase equipment is being added to transmit fourteen miles at 10,000 volts, and eight turbine wheels with shafting have been supplied by Smith, of York, Pa.; 300-hp will be furnished for railway work by means of a direct-connected motor generator. The lighting system steps down from 10,000 to 2300 volts at the substations and then down to 100 volts for use, and the change is also made from three to two-phase. In addition to this, the company is going in for an illuminating gas plant and has just bought a 30-ton ice plant of De la Vergne make and a Corliss steam engine. A large amount of power is furnished to mills and factories in the neighborhood. Mr. Barr was in New York a few days ago and spoke most hopefully of the situation in the South, stating that the new industrial development there was going on actively and solidly.

PITTSBURG REDUCTION COMPANY.—When the Pittsburg Reduction Company decided to enlarge its lower works at Niagara Falls it was evident that additional turbines and generators would have to be installed in the station of the Niagara Falls Hydraulic Power & Manufacturing Company, on which company's lands the plant referred to is located. In order to meet this demand for current the power company installed two new turbines,

which were built by R. D. Wood & Co., of Philadelphia. To these have been connected four 750-kw generators of Westinghouse make. Each of the turbines is rated at 2500-hp, and they are located on the large penstock last erected. They receive their water supply through 60-inch valves, the first on the penstock and closest to the cliff. The turbines and generators have recently been placed in operation, supplying current to the extension of the aluminum plant on the high bank above. Two new turbines ordered from the I. P. Morris Company will now be placed. When the I. P. Morris turbines are in place there will be three makes of turbines in the station. The wheels first installed were built by James Leffel & Co., of Springfield, O.; the next wheels came from R. D. Wood & Co., and now I. P. Morris Company have a contract. Working side by side, the efficiency of the various makes of wheels will be well tested.

EXTENSIONS OF THE WESTINGHOUSE WORKS.—A contract for a further considerable extension to the works of the Westinghouse Electric & Manufacturing Company, at East Pittsburg, has been awarded to W. F. Trimble & Sons, of Allegheny. The total extension is expected to be completed within four months after the steel work is placed on the ground. The Westinghouse Company are anxious to have the improvements proceeded with as rapidly as possible, as the additional space is necessary for keeping pace with their immense orders. The improvement will consist of an extension to the south of the east building, to make it equal in length to the main building. It will be 200 feet long and 76 feet wide, steel frame and brick. The same building will be extended at the northern end, making its continuous length 1206 feet, corresponding with the main aisle of the works. The most important part of the work, however, will be the erection of a high bay between the two main buildings. This will be 1206 feet long and about 65 feet wide, and added to the buildings on either side will give the company one of the largest shops in the world. The roof will be first erected over the space between the two buildings, and when completed the side walls will be torn out and the entire space thrown into one immense building. This will give the company a working space 1206 feet long and about 370 feet wide. The inside walls of the two buildings will be strengthened by the erection of heavy iron columns riveted to the old ones, and carried up 50 feet higher, upon which will be placed the roof and crane girders. It is the intention to carry on this work so as not to interfere with the manufacturing business. Work begins at once. The Westinghouse Electric & Manufacturing Company are at present completing a large extension to their East Pittsburg works, but the orders are coming in so fast for electrical apparatus that the capacity of the enormous plant has been sorely taxed. The company now has large orders not only for the United States, but for Europe, and no immediate relief can be had from the new plant of the British company at Manchester, as it is not expected to be completed for over a year.

CONSOLIDATED ELECTRIC LAMP COMPANY has been formed recently at Danvers, Mass., with a capital stock of $100,000, the officers being as follows: President, C. Willis Gould, of Chelsea; vice-president, Oscar G. Berry, of Boston; treasurer and general manager, Neal A. Moynahan, of Cambridge; clerk, Frank E. Rowell, Esq., of Kittery, Me.; assistant clerk and secretary, Frank E. Moynahan, of Danvers; directors, C. W. Gould, O. G. Berry, N. A. Moynahan, M. M. Merritt, F. E. Moynahan; superintendent, Matthew M. Merritt. Discussing the affairs of the company, the Danvers *Mirror* says: "No stock is for sale at present at any price. It is the desire of the company to greatly enlarge the capacity of the plant by adding machinery and other equipment and possibly by buying the Keith factory and additional land and enlarging the building extensively. The company has an option on a five years' lease of its present factory, but has only taken it for the present year. The company is now employing over thirty persons and making an average of 1000 lamps daily, which will at once be increased to 1500, and the employees will be materially increased in number. There are orders on hand for over 125,000 incandscent lamps, amounting to over $13,000, with others arriving daily."

BOILER PLATES AND TANKS.—In a recent issue the Pittsburg *Post* says: "Slashing of prices has been started by two of the largest steel and iron concerns in the country. The cuts are affecting two of the products, and there is danger of others being disturbed. It started with one class of material, and a second has followed in sympathy. The firms to the contest for business are the Carnegie Steel Company, Limited, and Jones & Laughlins, Limited. The products thus far sought to be put on the market are tank and boiler plates. One month ago tank plates sold at $62.50 a ton. Now they are selling at $45, a cut of $17.50. Boiler plates readily brought $62.50, and after the decline on tank material started it has reached the fifty-two-dollar mark. It is possible that it will ultimately follow closely in the footsteps of the tank product. As yet no efforts have been made looking to a re-establishment of prices, and as both are determined, with plenty of financial and other facilities, the near future will be watched with interest in iron and steel circles."

GENERAL ELECTRIC ON THE PACIFIC COAST.—The General Electric Company recently closed some important contracts through its Pacific Coast district agency in San Francisco. They include generating and other apparatus for the new Consolidated Electric Lighting & Power Company, organized in Santa Monica, Cal. There will be a 3-phase generator, having a capacity of 300-kw at 100 r. p. m.; a switchboard and step-up and step-down transformers for the Long Beach and Monrovia stations; also a 50-kw monocyclic machine for the Monrovia station. The present plant of the Santa Monica Electric Light & Power Company will be the nucleus of the Consolidated Company's central power station. Besides the above-named company, there will be in the consolidation the Long Beach & San Pedro Electrical Company and the Monrovia Electrical Power Company. The owners and promoters of the new company are Messrs. Carter and Davis, of the Santa Monica Company, and Mr. Frederick Rindge.

CONSOLIDATED MOTOR VEHICLE COMPANY.—The Consolidated Motor Vehicle Company, which recorded articles of incorporation at Newark, N. J., last week, was formed for the purpose of consolidating several Western motor vehicle companies. A statement to this effect was made by James B. Dill, president of the New Jersey Registration & Trust Company, who appears as counsel for the Consolidated Company. The new concern was incorporated with a capital stock of $1,000,000. It was intimated by Mr. Dill that the incorporators of the Consolidated Company and those of the Shelby Steel Tubing Company, which was incorporated a few days ago, were not entire strangers to each other. The Shelby Company has a capital stock of $15,000,000. Mr. Dill denied that the Consolidated Company had anything to do with another project for the merging of all the companies engaged in the manufacture of automobiles and bicycles.

PIECE WORK.—A recent newspaper article, syndicated by its writer, and the data for which appears to have been carefully collated, dealt with the General Electric works. The article is one of a series on the relations between trusts and their employees. Most of the facts are familiar to our readers, but a few new statistics are very interesting. It is stated that 98 per cent. of the work now done in the General Electric shops is piece work, and that the output has been increased in some instances 40 per cent. in consequence. The number of employees is given as 11,000, requiring $120,000 weekly in wages. There are 5900 at Schenectady. The total floor space of the three factories is put at 2,000,000 square feet. Schenectady is said to use up 3,000,000 pounds of steel and iron and 2,000,000 pounds of copper, and about the same quantity of sheet iron. In one gallery 180 girls are kept busy at nothing else but splitting mica.

LAWRENCE MACHINE COMPANY.—The contract for a 42,000 gallons per minute pumping plant for the St. Louis Transit Company, has been awarded to H. E. Maxfield, agent Lawrence Machine Company, 39-41 Cortlandt Street, New York City. Mr. Maxfield has also secured the following: An order for an electrically driven centrifugal pumping plant for Elmhurst, L. I., for which the United Company are engineers; a complete contract for a sewerage pumping plant to be installed for the Weston Electrical Instrument Company at their new factory at Waverly, N. J., and a complete contract for a pumping outfit for the new Havemeyer residence at Islip, L. I., for which Messrs. Waring, Chapman & Farquhar are the engineers.

CONTRACT FOR GLASGOW.—A special despatch of February 17 from Pittsburg says: "The Glasgow Tramway & Street Railway Company of Glasgow, Scotland, has awarded to the Riter-Conley Manufacturing Company, of this city, a contract for structural iron and plate work amounting to 1300 tons of shipment, and involving over $100,000. The work on the material for this large contract is now under way at the works here, and the Pittsburg concern expects to start work in Glasgow in April."

THE BERLIN IRON BRIDGE COMPANY, of East Berlin, Conn., have just completed two large highway bridges at Long Lake, N. Y., and are now putting up a 200-foot span at Stuyvesant Falls, N. Y. They have also in hand a large highway bridge at Hillsborough, N. H., and a two-span trolley bridge across the Naugatuck river at Waterbury, Conn.

PARIS EXPOSITION.—The Cross oil filter, manufactured by the Burt Manufacturing Company, of Akron, O., has been selected for use in the power house of the United States machinery exhibit at the Paris Exposition. The Burt Company will, however, make also an independent exhibit and have just made a fine shipment for that special purpose.

WESTINGHOUSE PROSPERITY.—The Westinghouse Electric & Manufacturing Company is at present doing the biggest business in its history and orders are being turned out, it is said, at the East Pittsburg shops aggregating $1,500,000 a month, or at the rate of $18,000,000 a year.

Special Correspondence.

FOREIGN NOTES.

London Office of Electrical World and Engineer, Feb. 10, 1900.

ST. MARTINS-IN-THE-FIELDS.—The parish of St. Martins-in-the-Fields, following the example of various other metropolitan parishes, has resolved upon an electric lighting system. About 100 electric light posts are to be put up; the work of setting them up has commenced.

CHICHESTER.—A meeting of the Chichester town council was held recently which, after a warm discussion on the subject of installing an electric lighting plant in the city, decided to postpone any action thereon for the present chiefly from financial reasons, as Chichester's present debt is about $550,000 and it was not considered a good time to raise money.

THE CITY OF DUNDEE, in Scotland, is proposing to spend in the neighborhood of $125,000 for the development of its electric light and tramway system. It is proposed to use the necessary poles in the streets for the overhead tramway equipments for electric lighting purposes also. The mains in the thoroughfares along which the electric tramways will be laid, will be installed at the same time as the cables for the traction work.

BIRMINGHAM LIGHTING TENDERS.—The Electric Lighting Committee of the corporation of Birmingham has recommended that the following tenders be accepted: Messrs. E. Danks & Co., Limited, for boilers; Messrs. C. A. Parsons & Co., for steam dynamos, condenser, feed water heater and traveling crane; Messrs. Cowans, Limited, for switchboard; the British Insulated Wire Company, Limited, for cables; the Tudor Accumulator Company, Limited, for storage battery and connections.

IMPROVED WIRELESS TELEGRAPHY.—An Italian electrician, Emilio Guarini, is reported to have discovered the means for utilizing Marconi's wireless telegraphy over the greatest distances by a repeater, which receives the electric waves, and is capable of transmitting them to other repeaters. There need only be a repeater at every five-hundredth mile, it is said, in order to establish communication with any given point of the surface of the earth. Emilio Guarini is a youth, little more than 20 years of age.

THE WEST BROMWICH TOWN COUNCIL have accepted the report of the Electric Lighting Committee. The tenders for the supply of boilers, steam dynamos and the whole equipments necessary of the following companies have been recommended to be accepted: Messrs. E. Danks & Co., for boilers; Messrs. C. A. Parsons, for steam dynamos, condenser, feed water heater and traveling crane; Messrs. Cowans, Ltd., for switchboard; the British Insulated Wire Company, for cables; the Tudor Accumulator Company, Ltd., for storage battery and connections.

THE WALKER & WALLSEND UNION GAS COMPANY have deposited a bill for next session to extend their powers to supply electricity within the borough of Jarrow and the urban district of Hebburn. By this company's act of 1899, powers to supply electricity were granted within the urban districts of Wallsend and Willington Quay and Willington, and it is believed by the company that an extension to Jarrow and Hebburn will not materially add to the initial cost of generating the supply. It is proposed to raise $1,250,000 additional ordinary capital and $262,500 of further debenture stock.

GLASGOW CENTRE, I. E. E.—At a recent meeting of the Glasgow Centre of the Institution of Electrical Engineers the following office bearers were duly elected: Lord Kelvin was unanimously elected chairman and for the post of vice-chairman there were three nominations, viz., Mr. Andrew Jamieson, Mr. Henry A. Mavor and Prof. Magnus Maclean. By a division Professor Maclean was elected. Prof. W. H. Watkinson was unanimously elected secretary, and the following gentlemen were elected members of the committee: Henry A. Mavor, W. B. Sayers, Francis Teague, W. A. Chamen, Andrew Jamieson, W. Lackie, J. M. M. Munro, Thomas Young.

ROENTGEN RAY APPARATUS is becoming an important accessory to the field hospitals in South Africa, and is doing extremely good work. Many of the surgical operations performed have been greatly assisted by means of this apparatus, and in consequence of the good results obtained many orders have been received in London for fresh equipments with skilled operators. The two hospital ships, the "Princess of Wales" and the "Maine" (the latter fitted up by American sympathizers), were also fitted with X-ray installations and it is comforting to know that the government is recognizing so fully the value of this wonderful device.

THE BIOGRAPH IN DIVORCE CASES.—One of the most extraordinary uses to which the biograph and mutoscope is now being put is shown by an advertisement of the Detective Bureau, in which the proprietor asserts that "he is prepared to introduce this latest and most wonderful innovation in photographs in connection with all divorce cases and to have pictures reproduced in court free of charge." This is a use of the biograph which, we venture to say, was never anticipated by the inventors, and we are not quite clear as to how the Detective Bureau proposes to introduce the biograph or the mutoscope at the proper time and place. It has been done in the theatre at one of the melodramatic plays produced in Drury Lane, where such things can be easily arranged, but we have never yet heard of its being attempted in actual life.

GLOUCESTER CITY COUNCIL have just accepted the following tenders for an extension plant as recommended by the Electricity Supply Company: Boiler house plant, $4775, Messrs. Tinders, Limited; engine house plant, $19,940, Messrs. Mather & Platt, Limited; extension of switchboard, $1255, Messrs. Crompton & Co., Limited; condensing plant, $2415, Messrs. E. Chester & Co., Limited. The engineer, Mr. Hammond, submitted a statement showing that a further sum of $47,125 was required for the electricity work and $42,875 for the refuse destructor. It was afterwards stated with the present plant there were 12,000 lamps available; 9770 applications had been received, while 2000 would be required for public lighting. It was decided to apply for sanction to the necessary loan.

THE CORPORATION OF SUDBURY have given their sanction to a somewhat ambitious scheme for introducing the electric light and at the same time combining the necessary plant with the destruction of refuse. The electrical expert consulted, Mr. Hawtayne, presented an elaborate report on the subject at a recent meeting of the town council. According to this, the total cost of the plant and works is estimated at $81,500, and after taking into consideration the gross revenue, the cost of working and the repayment of capital and interest, there would be left a net profit of $1548. This is on the basis of the repayment of capital and interest for 30 years, after the profits would materially increase. Electric light would be supplied to consumers at a price equivalent to gas as 72 cents per 1000 feet. The corporation have received requests to the extent of over 1000 lights. As regards the refuse destructor, they also approve of the report of the borough engineer, who has visited several towns and believe that the estimate Mr. Hawtayne places upon the steam raising power to be derived from refuse is much under what they may reasonably expect.

PLANT FOR GOVAN.—The borough of Govan, which is a part of Glasgow, has just inaugurated its own supply of electricity. The opening of these electricity works in the borough of Govan is bringing to notice rather a curious state of affairs, as the corporation of Glasgow furnishes that borough with its gas, but seems to have failed utterly in being able to make arrangements with the Govan authorities for their electric lighting. Glasgow also, some time ago, sought power of parliament to supply electric light to the Clyde trust, where it was within the borough of Govan, but this also was strongly opposed and eventually fell through where Govan was concerned. The Govan authorities, therefore, decided to build their own station, and in May last the work was commenced, the cost of which was estimated to be about $90,000. The plant is very complete, the plans having been prepared by Mr. Arnott, of Glasgow, late city electrical engineer. It was decided to adopt the continuous current system at 500 volts. The plant is equipped with Babcock & Wilcox boilers and with two 140-hp engines made by Belliss & Morcom, of Birmingham, with capacity for another engine if required of 300-hp. The British Thomson-Houston Company have furnished the dynamos and a Tudor battery has also been installed of such capacity that should there be any mishap to the engines they would carry the output for nearly five hours. Govan expects to receive quite a large demand for motor power, as there is in the vicinity a large number of important shipyards and factories, many of which, it is expected, will use electric power for their machinery. Already one of the yards—the London and Glasgow, Limited—has applied for electric power for their works.

General News.

THE TELEPHONE.

PONTIAC, MICH.—The Pontiac Telephone Company will apply for a franchise here.

DOWAGIAC, MICH.—The Wolverine Telephone Company has been organized here, with local capital.

ATLANTIC CITY, N. J.—The Delaware & Atlantic Telephone Company is building a line from Lakewood to Absecom.

HUNTINGTON, W. VA.—The Huntington Mutual Telephone Company is improving its system at an outlay of $60,000.

OSHKOSH, WIS.—The Little Wolf Telephone Company, of Oshkosh, has increased its capital stock from $8000 to $25,000.

HUNTSVILLE, ALA.—The Independent Telephone Company has begun work on its new telephone exchange in this city.

PARIS, TEXAS.—The Southwestern Telegraph & Telephone Company's extension from Greenville to Paris has been completed.

TROY, N. Y.—The council Law Committee is considering the application of a new telephone company for a franchise in this city.

ELBA, N. Y.—Managers of the Bell Telephone Company have been in Elba, securing right of way for a line from Akron to Bergen.

BROWNSVILLE, TENN.—Right of way and permission to erect poles, etc., have been granted to the Progress Telephone Company.

PORTLAND, IND.—The City Council has granted a franchise to Boyd & Lalley, of Truman, Ohio, to construct telephone lines in this city.

VANCOUVER, B. C.—The Vancouver telephone system was considerably damaged by a recent windstorm and the long distance lines were down for some time.

DENVER, COLO.—The Rocky Mountain Bell Telephone Company has amended its articles of incorporation, increasing the capital stock from $1,000,000 to $2,500,000.

NIAGARA FALLS, N. Y.—The Bell Telephone Company is finishing its new exchange building here. The building is now all ready to receive the switchboard, wires, etc.

WASHINGTON, D. C.—Senator Baker has introduced a bill authorizing J. H. Arter and Davis Hill to construct and operate telephone systems in the Indian Territory and Oklahoma.

NORTH VERNON, IND.—The North Vernon & Vernon Telephone Company has been incorporated with a capital stock of $10,000. Directors, Charles, Samuel, Ida B. and Ida E. Wright.

MINNEAPOLIS, MINN.—The Mississippi Valley Telephone Company has given a mortgage for $65,000 on all its property in the Twin Cities, including its franchise, to John E. Andrus.

FLOURSVILLE, TENN.—The Floursville Telephone Company has been incorporated. Capital, $250. Incorporators, J. A. Wooly, C. C. Hale, D. G. Boshaw, B. D. Briscoe, W. V. Devalt.

CENTER, OHIO.—The Eureka Telephone Company has been organized here with a capital stock of $600. Incorporators, C. Duckwall, A. M. Myers, B. F. Cory, F. A. Pausing, A. Stockman and others.

PITTSBURG, PA.—The Pittsburg & Allegheny Telephone Company will have its new plant in Pittsburg ready for operation by May 1. Many of the necessary preparations have already been completed.

WHEELING, W. VA.—The Home Construction & Telephone Company has been incorporated. Capital, $200,000. Incorporators, G. Hook, A. Paull, W. A. Wilson, H. S. Sands, W. T. Shaffer, all of Wheeling.

STANTONVILLE, TENN.—The Stantonville Telephone Company has been incorporated. Capital, $1000. Incorporators, J. R. Hurly, L. A. Lockman, N. A. Ervin, J. R. Gooch, J. Jenkins, all of Stantonville.

SAN FRANCISCO, CAL.—The Pacific Coast Telephone companies made a net gain of 2155 subscribers in January. The total number connected Jan. 31 was 66,693, including 17,352 in San Francisco.

BOSTON, MASS.—Among the objects of the Oxygen Explosive Company, of this city, recently incorporated in Delaware, is the construction of telegraph and telephone lines. The company's capital is $500,000.

SOUTH BEND, IND.—Work on the new system of the Bell Company is progressing rapidly. Seven hundred and sixty-six telephones are in operation, and a hundred or more applications remain to be filled.

EVANSVILLE, IND.—The Cumberland Telephone Company has agreed to give the county the free use of 10 long distance telephones in return for the privilege of using the roads of the county for its telephone lines.

NASHVILLE, TENN.—President J. E. Caldwell, of the Cumberland Telephone & Telegraph Company, has purchased the People's Telephone Company, of New Orleans, from the Detroit Telephone & Switchboard Company.

MORRISTOWN, TENN.—The Citizens' Telephone Company, of Morristown, has been incorporated. Capital, $3000. Incorporators, J. S. Hill, J. G. Hayse, M. C. McCaulip, O. H. Ponder, L. W. Brown, all of Morristown.

INDIANAPOLIS, IND.—S. P. Sheerin, vice-president of the new telephone company, insists that the consolidation and absorption of the Michigan companies by the Bell Company has not and will not affect the independent lines.

BROOKLYN, N. Y.—The Brooklyn Rapid Transit Railroad Company has decided to put telephones in all the stations of the elevated lines in order that news regarding a blockade, when one occurs, can be sent from one station to another.

COOKEVILLE, TENN.—The Cookeville Co-operative Telephone & Telegraph Company has been incorporated. Capital stock, $5000. Incorporators, O. C. Conatson, L. B. Pennock, John W. Wright, W. G. Pennock and J. W. Walter.

MENOMINEE, MICH.—The Michigan Telephone Company's long distance line is now completed between Menominee, Iron Mountain and other range towns, and by March 15 will be in full operation between Menominee and Marquette.

SUPERIOR, WIS.—The People's Telephone Company recently elected officers as follows: President, Frank Ostrander; vice-president, W. M. Hubbard; secretary and treasurer, C. C. Kreitzer. The new 1800-line board is now being installed.

SAN ANTONIO, TEXAS.—H. M. Aubrey, Frank Smith and Harry Daugherty, of San Antonio; C. N. Haskell, of Detroit, Mich.; J. S. Brailey, of Wauseon, Ohio, and others have obtained franchise for telephone system, and will, it is said, expend about $225,000.

PITTSBURG, PA.—The Board of Directors of the Central District and Printing Telegraph Company has increased the capital stock of the company from $4,000,000 to $7,500,000. The increase is to be used in the betterment of the telephone service in this city and vicinity.

JOHNSTOWN, IND.—The stockholders of the Indiana County Telephone Company have elected officers as follows: M. C. Watson, president; S. J. Telford, secretary; J. M. Watt, treasurer; J. C. Rugh, superintendent; Thomas Hart, J. A. Findley and H. S. Thompson, directors.

FINDLAY, OHIO.—The Central Union Telephone Company is preparing to modernize its exchange at Findlay. A new switchboard will be installed and the central energy system will be adopted. A large number of overhead cables will be put up. The improvements will cost about $40,000.

BELLEVUE, PA.—A franchise has been granted to the Maryland, Pennsylvania & West Virginia Telephone & Telegraph Company. The company agrees to have the line in operation within one year and to furnish residence telephones at a minimum rental of $18 a year and $24 for business telephones.

LANSING, MICH.—The Independent Telephone Exchange, of this city, has been transferred to the Grand Rapids Citizens' Telephone Company, the leading independent company of the state. While the price is not given, it is understood that the Lansing stockholders exchanged their stock in the local company for an equal amount of stock in the consolidated company.

CINCINNATI, OHIO.—The local telephone company has made a five-year contract with the Baltimore & Ohio Southwestern Railway Company for a complete private branch telephone exchange, to be located at its headquarters in the Central Union depot building in Cincinnati. There will be 10 trunk lines connecting the switchboard with the telephone company's main exchange.

CINCINNATI, OHIO.—All the city and county departments (Cincinnati and Hamilton County) have executed the five-year contract for telephone service submitted by the Bell Telephone Company, controlling all the local lines. By its provisions the contracts are simply annual ones, and do not bind the successors of the present incumbents to keep the service, if it objectionable.

DUBUQUE, IOWA.—The Iowa Telephone Company has made a big reduction in rates and will offer better service here. The new rates which the company has made for long distance telephones are as follows: Independent line, business, $48; residence, $39; party lines, two on line, business, $36; residence, $32; three on line, business, $30; residence, $27; four on line, business, $27; residence, $24.

MEMPHIS, TENN.—Mr. George W. Scheuing, treasurer of the Southern Independent Telephone Association and owner of exchanges at Water Valley and Greenwood, Miss., has resigned his position as foreman of the machinery department of the shops of the Southern Railway Company, of this city, and has accepted a similar position with the Louisville & Nashville road at Paris, Tenn.

SAN FRANCISCO, CAL.—The San Francisco board of supervisors recently passed an order imposing a tax of 50 cents per quarter on each nickel-in-the-slot telephone in the city. It is said that there are 18,000 of such telephones in the city and the annual income from the tax would accordingly be $36,000. Mayor Phelan vetoed a similar order a short time ago, but he is expected to sign the new measure.

WASHINGTON, D. C.—The Washington Telephone & Telegraph Company has made a proposition to establish a telephone system in the district. The company was recently chartered in New Jersey, with a capital of $1,500,000, and its leading stockholders are said to be Baltimore men. The new concern proposes to provide a service fully equipped with metallic circuits and latest improved instruments at rates of $36 yearly for residences and $48 yearly for business houses.

MEMPHIS, TENN.—The Tennessee & Arkansas Telephone Company now has long distance Bell telephones on its lines between this city and Osceola, Ark. Six dollars per annum is paid the Cumberland and the Southwestern Telephone & Telegraph companies for the use of the instruments, and, in addition to this, a division of the tolls is arranged for. The old telephones which have been in use on the Osceola line will be used in business houses at Osceola by the Osceola Telephone Company. Mr. A. M. Gibson will be in charge of the Memphis and Osceola line and also the Osceola Telephone Exchange, with headquarters at Osceola, Ark.

MICHIGAN TELEPHONE COMPANY.—Twelve thousand independent telephone subscribers, located in 55 cities of Michigan, and 7500 miles of long distance lines were transferred to the Michigan Bell Telephone Company last week. The above represents 80 per cent. of the independent telephone business of the state. This includes the telephone properties owned by the Detroit Independent Telephone Company, the New State Independent Telephone Company, the Central Telephone Company, the Kalamazoo Telephone Company and the Dowagiac Telephone Company. Five thousand and twenty-six telephone users in Detroit have petitioned for an immediate consolidation of the two systems. When amalgamated, Detroit will have a system of 12,000 subscribers.

PHILADELPHIA, PA.—The Interstate Telephone & Telegraph Company, which was lately incorporated with a capital stock of $2,000,000 for the purpose of connecting all local telephone companies in Pennsylvania, New Jersey and Delaware, has elected the following officers: C. W. Kline, of Hazleton, president; Dr. C. A. Eisenhart, of York, vice-president; A. M. Worstall, of Philadelphia, secretary; Major Thomas Daugherty, of Allentown, treasurer. The directors are: George O. Albright, Allentown; G. S. W. Brubaker, Philadelphia; Thomas Daugherty, Allentown; C. A. Eisenhart, York; J. P. Helfenstein, Shamokin; C. W. Kline, Hazleton; J. C. Landis, Norristown; C. A. Mans, Hazleton; Alvan Markle, Scranton; A. G. Scholl, Mifflintown; James Virdin, Dover, Del.; S. E. Wayland, Wilkesbarre; A. M. Worstall, Philadelphia; H. C. Young, Columbia.

ELECTRIC LIGHT AND POWER.

TWO RIVERS, WIS.—This city has decided to issue $50,000 electric light and water works bonds.

ALLIANCE, OHIO.—The Alliance Gas & Electric Light Company has been incorporated with a capital stock of $35,000.

WINSTON, N. C.—The Fries Manufacturing & Power Company is placing additional machinery in its electric power plant.

ATLANTA, GA.—An election will be held here to vote on the question of issuing $300,000 bonds for an electric light plant.

HAGERSTON, IND.—This town has contracted with parties from Peoria, Ill., to erect an electric light plant, to be owned by the town.

CARLYLE, ILL.—A committee has been appointed by the City Council to obtain the necessary plans and specifications for an electric lighting plant for this city.

WOONSOCKET, S. D.—Arrangements are being made here for putting in an electric light plant to be run by a gasoline engine or by artesian water power.

DENVER, COLO.—The Colorado Springs Power Company filed articles of incorporation. The incorporators are W. P. Bonbright, W. A. Otis and L. E. Curtis.

JERSEYVILLE, ILL.—The city council has granted the Jerseyville Electric Light & Power Company a twenty-five year franchise for light and heating purposes.

CAMDEN, N. J.—Isaac Ferris, George Barrett and J. C. Coxey, of Camden, N. J., are interested in the proposed electric light, heat and power plant at Ocean City, N. J.

MT. PLEASANT, TENN.—E. L. Gregory, C. H. Ingram, H. D. Ruhm, J. G. Ingram and others have incorporated the Mt. Pleasant Electric Company, with capital stock of $15,000.

SALT LAKE CITY, UTAH.—The American Fork Electric Power Company has closed contracts with the General Electric Company for a complete light and power plant of the latest type.

ST. CLOUD, MINN.—The Great Northern Railroad is building a new electric light plant for its shops in this place. Peter Hervin, building engineer of the road, is supervising the construction.

BOERNE, TEXAS.—The Boerne Electric Light & Power Company has been incorporated with a capital of $4000. Incorporators, A. H. Davidson, F. W. Wassenich, C. C. McFarland, all of Boerne.

PROVO, UTAH.—The Electric Company has been incorporated here. Capital, $50,000. Incorporators, R. Smoot, A. L. Woodhouse, C. E. Loose, L. Holbrook, all of Provo; W. L. Biersack, of Telluride.

ROSLYN, L. I.—The board of highway commissioners of the town of North Hempstead has granted to the Roslyn Heat, Light & Power Company permission to erect poles and string wires along the town highways.

TWO RIVERS, WIS.—A. B. Leyse, city clerk of Two Rivers, states that the city will install an electric light and water plant during the coming year, but that plans and specifications have not yet been completed.

NEWPORT, KY.—The Kentucky Electric Company, of Ludlow, has offered to furnish light to this city at ten cents per kilowatt hour, and to pay twenty-five cents per annum for each pole erected within the city limits.

DAYTON, OHIO.—The Citizens' Electric Light, Power & Heating Company, of this city, has been incorporated, with a capital stock of $200,000. The incorporators are W. T. Block, G. G. Luthy, W. Craighead and J. W. Krertzer.

REDLANDS, CAL.—The Redlands Electric Light & Power Company is installing an auxiliary 600-kw electric power plant driven by a steam engine. It is located in the town of Redlands, and is to be used in case of shortage of water power.

TORONTO, ONT.—The Electric Light Company, of Toronto, Ont., purpose erecting immediately a large machine and repair shop, and later on a new power house and an extension to an existing building to accommodate additional boilers.

GRAND RAPIDS, MICH.—The Elwell-Parker Company, of Cleveland, has recently completed a lighting plant for the Grand Rapids & Indiana Railway Company. The installation consists of two 50-hp Ball engines and two 30-kw generators, direct connected.

CLEVELAND, OHIO.—The Consumers' Electric Light Company, of Cleveland, organized some time ago, has been so successful in securing subscribers for its service, that plans are being made to erect a power house and commence operations as soon as possible.

EVANSTON, ILL.—Arrangements have been made by the Evanston Electric Illuminating Company to remodel its power house and to re-equip its plant with entirely new steam and electrical machinery. The power house and the machinery of the plant were damaged by fire and water last December.

WASHINGTON, D. C.—A bill has been introduced in the senate providing for the licensing of persons acting as electric wiring contractors in the District of Columbia, and making it unlawful for any person to engage in electric construction who is not an employee of such licensed contractor.

BAKERSFIELD, CAL.—The Power Development Company, Bakersfield, Cal., is installing an additional 450-kw generator and step-up transfomers in the power station of the transmission plant. The contract was awarded to the General Electric Company, which has also closed contracts for a lot of vertical shaft motors used to operate centrifugal irrigating pumps.

HAMILTON, ONT.—At the annual meeting of the Hamilton Electric Light & Cataract Power Company the following officers and directors were elected: Hon. J. M. Gibson, president; James Dixon, vice-president; John Moodie, treasurer; John Patterson, secretary; J. W. Sutherland, J. A. Kammerer, John Dickenson, Toronto, and Allan B. Forbes and Edward P. Smith, Chicago.

SANTA CRUZ, CAL.—The Big Creek Power Company, of Santa Cruz, Cal., recently sold its electric transmission plant and other property to Messrs. F. W. Billings and J. Q. Packard, the latter being a mining man of Salt Lake. The consideration is placed at $250,000. The plant, which supplies current for electric lighting and railway purposes, will be increased in capacity and the pole line to Santa Cruz will be duplicated.

PITTSBURG, PA.—The Allegheny County Light Company held its annual meeting last Tuesday, and elected the following board of directors: James D. Callery, J. H. Reed, T. H. Given, C. L. Magee, Patrick Calhoun, Joshua Rhodes, George H. Frazier, M. K. McMullin, and H. J. Bowdoin. The officers of the company are James D. Callery, president; T. H. Given, treasurer, and John Murphy, general superintendent.

ELECTRIC CANAL LOCKS.—At Albany, N. Y., on Feb. 14, Assemblyman Sage introduced a bill to authorize Henry Curtis Spalding and others to operate a system of electrical locks for canalboat transit between high and low levels, upon one side of the locks at Lockport. After a trial of three months the canal board shall have the right to take over the works for state use on payment of a sum not exceeding $500,000. The bill is introduced, it is alleged, against the wishes of the canal commission.

CLEVELAND, OHIO.—The Westinghouse Electric & Manufacturing Company, through its Cleveland branch office, is at work on an electric drive power plant for the Ohio Baking Company of this city. The installation includes a 75-kw two-phase generator, 720 r.p.m. 7200 alternations, a 125-volt exciter, a marble switchboard, and six motors aggregating 95-hp. The engine is a 125-hp Buckeye, and the boilers are of the Sterling water tube type. H. J. Prather, of Pittsburg, is the consulting engineer.

MANCHESTER, N. H.—The Manchester Electric Light Company expects to develop the water power at Garvin's Falls, N. H., 13 miles above Manchester, on the Merrimac River. The work will be begun in the early spring, and by fall a plant transmitting from 5000 to 6000-hp will be in operation. The power is to be used by the Manchester Electric Light Company, for street railway, lighting and power purposes in the city of Manchester and vicinity. Mr. J. Brodie Smith is general manager.

UNDERGROUND WIRES.—At Albany, on Feb. 14, Assemblyman Prince introduced a bill providing that no provisions of existing law shall authorize the erection of any telegraph, telephone or electric poles and wires in cities of 50,000 inhabitants or over, except such as are now or may hereafter be erected in connection with underground systems, without the consent of a majority of the property owners. All poles and wires now erected, except those in connection with underground systems, shall be removed within one year.

CLEVELAND, OHIO.—The Acme Machinery Company, of Cleveland, is the latest concern in this city to adopt electric power. A new power house is under way and contracts were placed a few days ago with the Elwell-Parker Company of Cleveland for a 100-kw generator and six motors aggregating 70-hp. The generator will be direct connected to an automatic engine of 150-hp, built by the Skinner Engineering Company, of Erie. The boilers are to be furnished by the Babcock & Wilcox Company, of Brooklyn. The Elwell-Parker Company will also furnish the switchboard.

ST. LOUIS, MO.—The Board of Public Improvements, Feb. 6, opened the bids for the permanent 10-year city lighting contracts. For lighting the business section of the city east of Jefferson Avenue, the bids were: Laclede Company, $30 per 1000 arc lamp hours, $6 per 1000 incandescent lamp hours; Imperial Company, $19.87 per 1000 arc lamp hours, $4.87 per 1000 incandescent lamp hours; Missouri-Edison, $32.90 per 1000 arc lamp hours; $5.84 per 1000 incandescent lamp hours; H. R. Budd, $11.60 per 1000 arc lamp hours, $2.35 per 1000 incandescent lamp hours. The bids were referred.

NEW HAVEN, CONN.—The report of the Inspector of the New Haven (Conn.) lamp department, Mr. Henry Hopkins, shows that on Dec. 31, 1899, 491 arc lamps were used in the city. The city is now paying for these lamps 25 cents per night per lamp, this rate being based upon a contract entered into last July. Referring to the subject of municipal ownership of the lighting plant, Mr. Hopkins says that the saving, if any, is not worth the risk of trying the experiment. A fixed and stated cost is preferable, he states, to an estimated and unknown expense under a continual changing policy.

THE ELECTRIC RAILWAY.

ROME, N. Y.—James W. Brown has been appointed manager of the Rome City Street Railroad.

SEATTLE, WASH.—A street railway franchise has been granted to J. D. Lowman and Jacob Furth.

YOUNGSTOWN, OHIO.—The city council has granted the Youngstown & Sharon Electric Railway a right of way over the streets.

RYE, N. H.—Contracts have been signed for the erection of a power house at Rye, for the Portsmouth, Rye & Hampton Electric Railway.

HARTFORD, CONN.—The proposed electric railway between Torrington and Terryville will likely be built. The survey was made last November.

CLEVELAND, OHIO.—Mr. Ira A. McCormack has become general manager of the lines of the Cleveland Electric Railway Company, Cleveland.

SAN FRANCISCO, CAL.—The Market Street Railway Company, San Francisco, recently completed an extension of the Twenty-fourth Street electric line.

PITTSBURG, PA.—The work of merging the Consolidated Traction Company and the Union Traction Company into one concern will be consummated by spring.

SAGINAW, MICH.—It is stated that a deal is being considered for the consolidation of the Saginaw Valley Traction Company and Bay City Consolidated lines.

AKRON, OHIO.—The semi-annual dividend of 2½ per cent. has been declared by the Northern Ohio Traction Company on its preferred stock of $500,000.

URBANA, OHIO.—The Dayton, Springfield & Urbana Electric Railway, operating from Dayton to Urbana, Ohio, was completed and commenced operations last week.

LOUISVILLE, KY.—The Louisville Railway Relief Association has been organized. Its purpose is to aid street railway employees by paying sick benefits from dues paid by the members.

DUNKIRK, N. Y.—The Dunkirk & Fredonia Electric Railroad Company has decided to demand damages from the village of Fredonia for $10,000, for the 10 cars burned in the recent fire.

RAHWAY, N. J.—It is announced that the Riker Electric Railway Syndicate has absorbed the Rahway-Sewaren Electric Road, better known as the Union & Middlesex Traction Company.

BALTIMORE, MD.—The Baltimore County Commissioners have granted a franchise to the Baltimore, Halethorpe & St. Denis Railway Company. Mr. Oregon R. Benson, of Catonsville, is president of the company.

SANDUSKY, OHIO.—The Sandusky, Monroeville, Bellevue & Norwalk Traction Company has been incorporated. Capital, $600,000. Incorporators: H. W. Hughes, W. W. Graham, W. E. Guerin, C. Rude, W. P. Ruis.

GLENS FALLS, N. Y.—The Saratoga & Northern Railway, which was to build a trolley line from Saratoga to Glens Falls, has been dissolved. Joseph A. Powers has been appointed temporary receiver.

PITTSBURG, PA.—To meet the competition of the new Wilkinsburg & East Pittsburg branch of the Monongahela Traction Company, the United Traction Company has decided to reduce fares.

MILAN, MICH.—The franchises for the branch of the Detroit, Ann Arbor & Ypsilanti Electric Railway from Ypsilanti to Milan have all been secured and the road will be completed by fall.

DES MOINES, IA.—It is rumored that the General Electric Company is negotiating for the control of the General City Railway Company of this city. Officers of the company admit contemplating the purchase of the franchise and plant.

GREENSBURG, IND.—The new electric railway, proposed to connect Greensburg and Madison, is assuming definite shape and it is believed that the construction will begin early in the spring. Nicholas Cornet, of Versailles, is interested.

HEMPSTEAD, L. I.—A franchise was granted to the Mineola, Hempstead & Freeport Traction Company for the right of way through Hempstead village. Two power houses, one at Freeport and another at Hempstead, will be constructed at once.

WILMINGTON, DEL.—The contract for building the New Castle & Delaware City Electric Railway has been awarded to the Delaware Construction Company, of this city. The road will be about nine miles long, and will connect the two towns.

WHEELING, W. VA.—At the annual meeting of the stockholders of the Wheeling Railway Company the old board of directors was re-elected as follows: Messrs. T. H. Conderman, H. C. Ford, F. W. Moore, L. F. Stifel, B. W. Peterson and J. J. Holloway.

DETROIT, MICH.—The Detroit Citizens' Street Railway Company re-elected the following officers at the annual meeting: Tom L. Johnson, president; J. C. Hutchins, vice-president and treasurer; Albert E. Peters, secretary; A. B. du Pont, manager; Albert H. Stanley, superintendent.

CHESTER, PA.—It is announced that the Southwestern Traction Company, of Philadelphia, has been absorbed by the United Power & Transportation Company. The latter corporation controls the lines of the Chester Traction Company and roads in Wilmington, Reading, Trenton and other places in this section of the country.

POUGHKEEPSIE, N. Y.—Attorney General Davis has brought suit in the Supreme Court to wind up the affairs of the Poughkeepsie City & Wappingers Falls Electric Railroad, and have a receiver appointed to take charge of the affairs of the corporation, which operates about twelve miles of railroad in the city of Poughkeepsie and vicinity.

MASSILLON, OHIO.—A franchise has been granted to the Massillon, Barberton & Doylestown Electric Railway Company. Under the terms of the franchise the company is to pay the county a rental of $25 per mile for the roadway, after 10 years. Franchises have been secured through Summit County and in all the towns through which the road will pass.

SEATTLE, WASH.—The Ballard division of the Seattle Consolidated Street Railways, controlled by the Seattle Electric Company, will be improved by the expenditure of $50,000 for constructing new trestles to replace the roadbed now in use. Several new cars are being built for this line. They will each have four motors of 40-hp each and will have a speed of 20 miles per hour.

TOLEDO, OHIO.—The Detroit & Toledo Electric Railway Company, which is preparing to build an electric line between Detroit, Mich., and Toledo, Ohio, has completed arrangements with the Toledo Traction Company to operate the line into the center of Toledo, running over the latter's tracks. A power house has been erected at Monroe, but it is stated that another one will be required.

MILFORD, MASS.—The Milford, Upton & Grafton Street Railway Company has been organized. The length of the line is to be 12½ miles, and the capitalization of the company $125,000. The board of directors is as follows: Charles G. Bancroft, of Boston; John Kelly, of Somerville; Charles L. Cotton, of Dedham; H. D. Bowker, W. D. Leahey, H. E. Morgan, of Milford, and S. B. Fiske, of Upton.

SEATTLE, WASH.—The Seattle Electric Company has obtained control of the Grant Street Electric Railway Company, which operates a line extending through the southern portion of the city and suburbs. Jacob Furth is said to have made the purchase for the Seattle Electric Company for $235,000. Stone & Webster recently secured control of $100,000 worth of bonds outstanding against the Grant Street Line. These securities were owned by the Electrical Securities Company, of Boston.

PORTLAND, ME.—A new electric railway has been formed to construct an electric railway from Huntington to Portland. The line will pierce rich farm land and afford transportation to Kelso, Warren and Montpelier. Private right of way will be purchased along the greater distance. Stock amounting to $10,000 has been subscribed for preliminary surveys and expenses, and arrangements already made to float $500,000 in bonds to construct and equip the road. The intention is to build the line and get it in operation this summer.

TOLEDO, OHIO.—The Toledo Traction Company has placed contracts for an extensive addition to its power house, to cost $20,000. A contract has been placed with the E. P. Allis Company, of Milwaukee, for one 2800-hp vertical compound condensing engine, direct connected to three General Electric Company's generators; two of them 14-pole, 500-kw direct current machines, and the other a 60 cycle, 3-phase, 500-kw alternator. A number of new cars have recently been ordered from the Barney Smith Co., of Dayton, Ohio. The company recently appropriated $200,000 for improvements to its system.

CLEVELAND, OHIO.—The Cleveland City Railway Company has asked that existing franchises, the first of which expires in eight years, be renewed for a period of 25 years from date. In return it agrees to pay into the city treasury $200,000 in cash and pay 17½ per cent. of the cost of abolishing all grade crossings on its lines. The company agrees to sell six tickets for a quarter, cash fare to remain at 5 cents. After the expiration of eight years, the life of the shortest existing franchise, the company offers to pay the city a percentage of its gross receipts, as follows: Two per cent. for the first five years, 3 per cent. for the second five years, 4 per cent. for the third five years, and 5 per cent. for the remaining two years of the grant. The company also agrees to pave and keep in repair 16 feet of the streets through which its lines run.

THE AUTOMOBILE.

THE REORGANIZATION of the Keating Wheel & Automobile Company, of Middletown, Conn., is under way.

THE AMERICAN AUTOCARETTE COMPANY, of Richmond, Va., has been chartered to manufacture automobile vehicles. The capital stock is $300,000. Mr. O. G. Staples, of Washington, D. C., is president.

THE AUTOMOBILE STREET SWEEPING COMPANY has been incorporated in Boston with a capital of $3,000,000. The incorporators are A. J. Reynolds, P. S. Young, B. Hall, H. B. Whall, E. L. Tierney, all of Boston, Mass.

RECEIVER ASKED FOR.—Application has been made for the appointment of a receiver for the Crouch Automobile Manufacturing & Transportation Company, of Baltimore, Md. This company was the first of its kind to be organized in Baltimore.

THE INTERNATIONAL ANDERSON MOBILE COMPANY has been incorporated at Charleston, W. Va. Capital, $2,000,000. Incorporators, G. E. Morris, G. W. Walmuth, A. F. Bouton, W. Fleming, C. F. Thompson, all of New York City.

THE NEW ENGLAND ELECTRIC VEHICLE TRANSPORTATION COMPANY, Boston, Mass., has issued a neat little pamphlet giving a schedule of rates for hansoms and coupes, rules and other pertinent information. The company offers advantages to persons renting vehicles by the month for private service. Half-tone illustrations of the various styles of vehicles are shown.

NEW INDUSTRIAL COMPANIES.

THE GEORGE A. WILLIAMS COMPANY has been incorporated in New Jersey, with a capital stock of $125,000 to conduct an electrical and mechanical engineering business. The incorporators are S. M. Williams, George A. Williams, Charles H. Tetter.

THE RANDALL-LOUDON ELECTRICAL COMPANY, of Memphis, Tenn., has just received a charter. This company will carry a small stock and do telephone and electric bell work. Capital stock, $2000. James D. Randall is president and manager, and Louis S. Loudon, secretary and treasurer.

THE CHESAPEAKE ELECTRIC COMPANY has been incorporated at Baltimore, Md., to deal in general electrical supplies. Benjamin C. Howard and Francis T. Homer, of Baltimore County; Eugene Greenway, of Harford County, and Alan M. Cohen and Jacob I. Cohen, of Baltimore City, are the incorporators. The capital stock is $20,000.

LEGAL.

THE BULLOCK ELECTRIC MANUFACTURING COMPANY filed a suit in equity in the United States Circuit Court, in St. Louis, Feb. 12, against George W. Knapp & Co., alleging that the defendant has infringed upon its patent for an improvement in apparatus for starting motors.

SUIT FOR INJUNCTION DISMISSED.—The American School of Correspondence, Boston, Mass., informs us that the suit brought against it some time ago by the Colliery Engineer Company, of Scranton, Pa., conducting the International Correspondence Schools, was recently dismissed by Judge Lacombe, of the United States Circuit Court, the plaintiffs refusing, it is stated, to argue the case after several postponements of the trial.

PERSONAL.

MR. GEORGE F. PORTER, representing W. R. Brixey, has gone on a business trip to Cuba in the interests of Kerite wire.

MR. R. A. FLIESS lectured on Feb. 17 before the electrical section of the American Institute on the subject of automobiles.

MR. C. O. POOLE, the new superintendent of the Standard Electric Company, of San Francisco, is making a visit to the eastern states.

MR. F. G. WATERHOUSE has been appointed general manager of the San Francisco Gas & Electric Co.'s electrical department, in place of Mr. J. E. Green, resigned.

MR. NEVIN A. NEVILLE, an electrical engineer of Berne, Switzerland, is in Pittsburg to visit the works of the Westinghouse Electric & Manufacturing Company at East Pittsburg.

MR. ALBERT MEINEMA, who has been with the George Cutter Company, of Chicago, for many years, is now with the Electrical Supply Company, of Madison, Wis.

MR. THEO. G. SEIXAS, superintendent of the Germantown Electric Light Company, Germantown, Philadelphia, has recently been appointed vice-president of the same company. He continues as superintendent.

MR. T. A. EDISON has returned home from Ohio, and has fairly well recovered from his recent illness, which threatened to be very serious, and which he contracted while attending the funeral of his sister, Mrs. Marion Page.

MR. H. H. VREELAND, president of the Metropolitan Street Railway Company, received on Feb. 14, from members of the Whitney syndicate a check for $100,000 in special recognition of valuable services. It is said not to have been the first of such marks of appreciation.

MR. W. J. JOHNSTON AT SINGAPORE.—A cablegram from Mr. W. J. Johnston, dated Feb. 19, announces his arrival at Singapore where, at the invitation of the Sultan Jihore, he inspected a magnificent 2500-guinea Australian racer just imported by that oriental monarch.

MR. A. E. LE ROSSIGNOL, M. I. E. E., resident engineer, of Newcastle, England, left for home on Saturday, after studying street railway conditions in New York, Chicago, Boston, Baltimore, Washington, Buffalo, Niagara Falls, Albany and Philadelphia. The Newcastle corporation is to put 150 trolley cars on about 15 miles of new double track. The power house will generate current at 500 volts direct, there being no necessity for long transmission. The specifications for the work have been prepared, and tenders will be asked for on his return to England.

MR. FREDERICK A. SCHEFFLER, who has been general factory manager of the Sprague Electric Company since Jan. 1, 1898, has resigned his position, to take effect on March 1 next. He has been with the company during the development of its elevator business, and has seen the Watsessing works undergo large extensions. Mr. Scheffler is not only a skilful manufacturer, but is well-known in the mechanical and electric railway engineering fields. He will not give out anything for publication as to his plans for the future, but it is understood that several tempting offers await his decision.

ENGINEERING SOCIETY LIBRARY, UNIVERSITY OF MICHIGAN

Trade Notes.

THE WALTHAM WATCH TOOL COMPANY, Springfield, Mass., reports a heavy demand for its milling machines. The company is about to move into a new and larger factory.

THE WESTERN ELECTRIC COMPANY has leased for 50 years from Jan. 1 the property at the southwest corner of Clinton and Van Buren streets, Chicago, with the privilege of purchase for $118,000.

THE CHICAGO INSULATED WIRE COMPANY has just built an addition, 50 by 100 feet, to its factory at Sycamore, Ill. It reports business extremely good, and it is running 12 hours per day.

THE ELECTRIC APPLIANCE COMPANY, Chicago, are very much pleased with their new agency for the Adams-Bagnall enclosed arc lamp. They state that their business for these lamps is growing in a remarkable degree.

THE SMITH INTERCHANGEABLE TELEPHONE COMPANY, of Chicago, has just secured the contract from the United States government to equip the army and navy hospital at Hot Springs, Ark., with its telephones.

THE BECK ELECTRIC COMPANY, St. Louis, Mo., filed articles of incorporation Feb. 8, with $5000 paid-up capital. Betty Beck, Morris Beck, Emil Haas and Arthur Beck are stockholders. It is proposed to carry on a general electrical business.

EMERY WHEELS AND GRINDING MACHINERY.—The Safety Emery Wheel Company, Springfield, Ohio, in an eight-page folder, gives dimensions and prices of its bench and tool grinders. Various sizes of these machines are illustrated.

MESSRS. FRANK H. STEWART & CO., 35 North Seventh Street, Philadelphia, Pa., are doing an excellent business in their combination socket handle and adjuster. It adjusts the length of lamp cord to any desired height with facility, and takes the strain off the socket connections.

PATENTS BY MAIL.—Mr. Edward P. Thompson, 81 Fulton Street, New York, is sending out a pamphlet to the trade giving much information regarding the taking out of patents. He has been in the business for 15 years and is well qualified from education and experience to handle matters of this nature.

THE CARLISLE & FINCH COMPANY, Cincinnati, Ohio, reports business good, particularly in domestic orders. "We are not particularly impressed with foreign business," said Mr. Finch, "and our force, more than double what it was this time last year, is kept busy on work for the United States and adjacent territory exclusively." This firm is looking out for more room.

THE BULLOCK ELECTRIC MANUFACTURING COMPANY shipped several teaser equipments for printing presses to London, Paris and other foreign centres last week. Vice-President Joseph S. Neave says the company has made more shipments of high class equipments to foreign countries the past month than during any previous month in its history.

THE AMERICAN ELECTRIC APPLIANCE COMPANY, Philadelphia, Pa., has issued a pamphlet on the subject of Star automatic electric circuit breakers manufactured by it. This circuit breaker automatically opens the circuit when the circuit exceeds a predetermined limit, and was especially designed for the protection from overloads on light and power circuits, motors on traveling cranes, machine tools, automobiles, printing presses and street railway cars.

THE "NEW STANDARD" DRY BATTERY.—Mr. William Roche, 42 Vesey Street, New York, manufacturer of the "New Standard" dry battery, has just issued a bright little pamphlet containing much information of interest to battery users. It contains copies of several letters which refer to the excellent qualities of this battery; also a fac-simile reproduction of an order from the navy department for a lot of dry cells for the U. S. torpedo station at Newport, R. I.

THE WARD LEONARD ELECTRIC COMPANY, Bronxville, N. Y., has brought out a very complete catalogue of 62 pages of its enamel rheostats and circuit breakers. The construction of these devices is described and illustrated, and tables give the dimensions, prices, code words, etc. The variety of apparatus illustrated is quite extensive, and a glance through the pages of the catalogue will no doubt carry astonishment to many as to the extent of this business.

MR. J. S. SPEER, St. Mary's, Pa., was a visitor to New York last week. The work which the Speer Carbon Company has done since its organization is quite remarkable. Mr. Speer's knowledge of the qualifications of a good carbon brush has been communicated to his factory hands, with the result that the Speer product has been sold in large quantities where an absolutely reliable brush is needed. In addition to motor and generator brushes the company manufactures carbons for open and enclosed arcs.

CATALOGUE OF WOOD ARC LAMP PARTS.—The Fort Wayne Electric Works, Fort Wayne, Ind., has just brought out a catalogue of parts of "Wood" open arc lamps and "Sure Grip" pulleys, which are manufactured by this company. Illustrations of the details of the lamp are given, each part being numbered to correspond with the number of the accompanying description and price. The catalogue is designed to facilitate renewals, and its arrangement offers a great help in that direction.

THE WILLIAMS-ABBOTT ELECTRIC COMPANY, of Cleveland, which has lately launched into the manufacture of complete telephones, will be on the market about March 1 with a new and complete switchboard. Mr. W. J. Barr, of the company, states that the board embodies several new features. A new desk set has been brought out recently. The connections are inside the top lug of the transmitter head, making them easy of access. This company has recently completed a complete exchange of 1250 telephones at Houston, Texas.

THE ELWELL-PARKER ELECTRIC COMPANY, of Cleveland, is at work on a large amount of electrical equipment for hoisting and conveying machinery being built by the Brown Hoisting & Conveying Machinery Company, of that city. Among them are several large-sized motors for a large hoisting outfit for the new Carrie furnaces of the Carnegie Steel Company. Also several motors of 225-hp each for an ore-handling plant to be erected at a Lake Erie port. A large export order for hoisting and conveying machinery is also being equipped with motors.

THE LAWTON-BEATTIE COMPANY, Cincinnati, Ohio, is finishing a contract for the rewiring and installation of electric window devices at the large furniture establishment of May, Stern & Co. They are also planning for a new plant for the Blymyer Machine Works—an entirely new plant throughout—and have just finished putting in one of the Cleveland Electric Manufacturing Company's watchmen's clock equipments at the Latonia distillery, known as distillery No. 2 of the new whiskey trust's properties. An equipment of 800 lights and power for the Harvard Piano Company in Dayton, Ky., has just been finished.

THE TRIUMPH ELECTRIC COMPANY, Cincinnati, Ohio, the past week received an order from the Galveston Red Snapper Company of Galveston, Texas, for a combination electric and ice manufacturing outfit. The order amounts to about $50,000. A similar outfit, worth about $25,000, was sold to go to Chillicothe. An order received through the Hancock Equipment Company, the Boston agents of the Triumph Company, calls for equipment for a complete lighting plant to be installed in one of the big department stores of Boston. Mr. L. P. Pennypacker, of Guatemala, Central America, has arranged to represent the Triumph Electric Company in the territory in the vicinity of his home in Central America.

THE WESTERN ELECTRICAL SUPPLY COMPANY, of St. Louis, have just issued to the trade two catalogues—one on direct and the other alternating current fan motors and ceiling fans. They are offering for alternating currents the new model 1900 Emerson desk fan motors and ceiling fans. This year's fan has a few minor improvements over last year's, but nothing radical, since the company claim that they have a fan as nearly perfect electrically and mechanically as can be made. Especial attention is called to the Parker noiseless blades with which all their fan motors are equipped. For direct current they are offering Peerless desk fan motors and ceiling fans, which are said to be simply and strongly made, graceful in appearance and practically noiseless in operation. It has self-oiling and self-aligning bearings and self-adjusting carbon brushes. They state they are now prepared to make shipments of these fans for any voltage. They mail these catalogues on application.

THE EMERSON ELECTRIC MANUFACTURING COMPANY, of St. Louis, Mo., are making a rather unusual proposition to the electrical trade, offering to send to any electrical dealer or central station of financial responsibility a sample of their desk and ceiling fans for alternating current on the following terms. Transportation charges on the samples are to be prepaid by the Emerson Electric Manufacturing Company, and the samples are sent with the understanding that if for any reason the motors are not satisfactory they may be returned within 30 days, the Emerson Company paying the return charges. This gives any electrical dealer or central station the opportunity of inspecting and testing the latest product of the Emerson factory, with absolutely no expense or liability whatever. The Emerson Electric Manufacturing Company request firms desiring samples, to order them on this basis, being careful to specify the exact voltages and alternations of the circuit on which the motors are to be tested.

Record of Electrical Patents.

UNITED STATES PATENTS, ISSUED FEB. 13, 1900.

[Conducted by William A. Rosenbaum, Patent Attorney, Times Bldg., N. Y.]

643,133. SAFETY DEVICE FOR ELECTRIC DISTRIBUTION SYSTEMS; E. M. Hewlett, Schenectady, N. Y. App. filed Jan. 3, 1899. (See Current News and Notes.)

643,148. ELECTRIC SIGNAL AND AUTOMATIC ALARM FOR RAILWAY TRAIN; J. K. Miller, J. W. Witt and D. A. Jones, of Oshkosh, Wis. App. filed July 13, 1899. This is a system by which signals may be sent from one part of a train to another, a signal being automatically given in case the train breaks in two.

643,162. ALTERNATING CURRENT METER; G. A. Scheeffer, Peoria, Ill. App. filed May 11, 1899. (See Current News and Notes.)

643,173. TARGET AND AUTOMATIC INDICATING APPARATUS; J. H. Van Viersen, M. P. T. D. Molière & C. E. Ter Meulen, of Amsterdam, Netherlands. App. filed Jan. 20, 1899. The target and firing stand are electrically connected, so that points upon the target where the shots strike will be telegraphed back. A sheet of paper is struck and perforated by the bullet and is immediately thereafter subjected to trailing contacts which by passing through the perforation close a circuit and indicate at the firing stand the point where the target was struck.

643,179. THERMO-STATIC APPARATUS; E. F. Woodman, Boston, Mass. App. filed March 28, 1899. The invention consists primarily in the use of a solder, which is subjected normally to a tensile strain, but is non-adherent to the contacts. It is claimed that by so disposing of the fusible material it will melt at a lower temperature than otherwise.

643,225. TELEPHONE REPEATER; James Houlehan, of Toledo, Ohio. App filed Sept. 14, 1899. The repeater consists of vibratory needle or armature centrally pivoted and having diaphragms on its opposite ends, facing electro-

magnets. The electromagnets are provided with extensions supporting a second set of diaphragms. Between the facing pairs of diaphragms and cemented thereto are interposed rubber contracts.

643,228. MEANS FOR CONTROLLING AND INDICATING THE SUPPLY OF ELECTRIC ENERGY; C. R. Loubery, Paris, France. App. filed May 23, 1899. This is a system for the distribution of electrical energy, which includes a local circuit, a coil in said circuit, means adapted to be actuated by the coil to indicate the consumption of electrical energy by the local consumer, a shunt around the coil, and auxiliary circuit and means adapted to be actuated thereby to close the shunt circuit.

643,255. ELECTRICALLY OPERATED DAY AND NIGHT SIGNAL FOR RAILWAYS; J. J. Saville and J. H. Winspear, Omaha, Neb. App. filed Aug. 13, 1898. The signal includes a colored light in a field of like color, a light of a different color located above that field, a shutter corresponding in color to the second light and normally hiding the first light and its field, electric devices for moving the shutter to position for hiding the second light, and exposing the first light and its field, and devices for hiding the shutter while in its second position.

643,276. ELECTRIC TRACTION MOTOR; C. Richter and R. T. Eschler, Camden, N. J. App. filed May 19, 1899. This motor is located in the car wheel the invention residing principally in the location of the brushes which are placed in cavities in the structure of the field magnet, the field magnet being carried by the axle and the armature by the rim of the wheel.

643,283. SYSTEM OF DISTRIBUTION FOR ELECTRIC RAILWAYS; W. Chapman, Washington, D. C. App. filed May 16, 1896. The system comprises a plurality of underground supply mains or main feeders, a corresponding number of underground sub-feeders, junction boxes located at intervals along the line and provided with means for connecting and disconnecting the individual supply means and the corresponding sub-feeders at will.

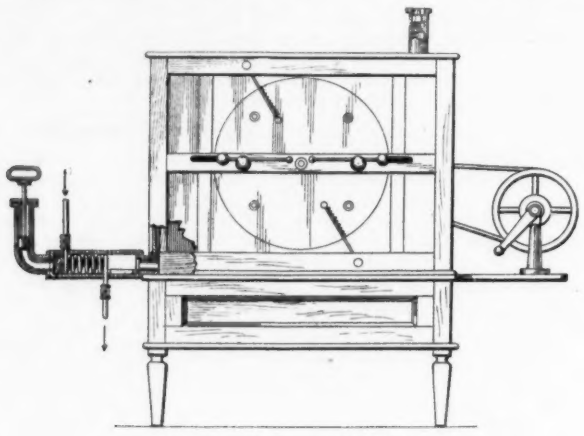
643,309. DEVICE FOR DISINFECTING TELEPHONES; W. H. Taylor, Stamford, Conn. App. filed March 9, 1899. The invention comprises a cap or cover for the mouth or ear piece of the instrument, having a hollow, resilient handle projecting from the top of the same and a nose piece or holder containing a disinfecting material and projecting from the underside of the cover.

643,327. MINE TROLLEY HANGER; G. E. Jamme, Jr., Pittsburg, Pa. App. filed June 17, 1899. The insulator which supports the trolley wire is carried at the end of a tube, the upper end of which is split and contains a projecting wedge. When the tube is driven into the ceiling of the mine the wedge spreads it and holds the insulator in place.

643,367. INFLUENCE MACHINE; H. E. Waite, New York, N. Y. App. filed Aug. 2, 1898. For the purpose of removing moisture from the case containing the machine, means are provided for forcing a current of dry air or gas through the casing while the machine is in operation.

643,379. PRINTING TELEGRAPH; L. Kamm, London, England. App. filed Nov. 21, 1898. This invention is an improvement upon the instrument described in patent No. 572,760 of Dec. 8, 1896.

643,392. ELECTRIC METER; J. H. Barker and J. A. Ewing, of Cambridge, England. App. filed Aug. 14, 1899. A pivoted or suspended magnetic



643,367.—Influence Machine.

brake comprising one or more magnets, a conductor moving in the magnetic field of the brake, means for controlling the motion of the brake, and an indicator for multiplying and exhibiting the amount of such motion.

643,401. ELECTRIC FLASHING SWITCH; A. L. Cotter, of Cleveland, Ohio. App. filed Sept. 15, 1899. A magnet throws the switch to produce the flashes of light in the lamps, but the movement of the armature of the magnet is controlled by a dash pot, which provides for an appreciable duration of the flash.

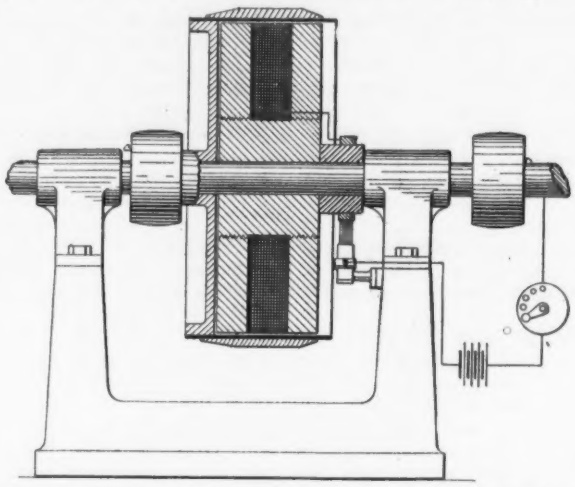
643,405. BURGLAR ALARM; J. T. Friend, Fort Wayne, Ind. App. filed Aug. 3, 1899. Details of construction.

643,413. ELECTRO MAGNETIC VARIABLE SPEED AND CLUTCH GEARING; R. Kennedy, of Leeds, England. App. filed Feb. 20, 1899. The object is to enable power to be transmitted gradually and without jar from a continuously rotating shaft to another shaft, the speed of transmission being varied as desired by varying the force of hold exerted by the clutch. The invention consists of a field magnet having one coil and a number of pole pieces between which the coil is disposed, the poles on one side of the coil being of one polarity, while those on the other side are of the opposite polarity. The armature is a structure of iron and copper closely surrounding the pole pieces. The pole pieces are connected with one rotary member, and the armature with the other.

643,414. SURFACE CONTACT STUD FOR ELECTRIC TRACTION; W. Kingsland, of London, Eng. App. filed Oct. 4, 1899. The stud is made in two parts, one of which is fixed permanently in the roadbed, while the other is in the nature of a cover telescoping thereinto.

643,442. CONTROLLER; T. Von Zweigbergk, Cleveland, Ohio. App. filed March 31, 1899. A position is provided for the main controller, where the motors will be closed upon themselves so that the momentum of the car will drive the motors as generators, thereby causing them to retard the car.

643,484. MICROPHONIC TRANSMITTER; G. F. Dupont, Paris, France. App. filed April 1, 1898. (See Current News and Notes.)



643,413.—Electromagnetic Variable Speed and Clutch Gearing.

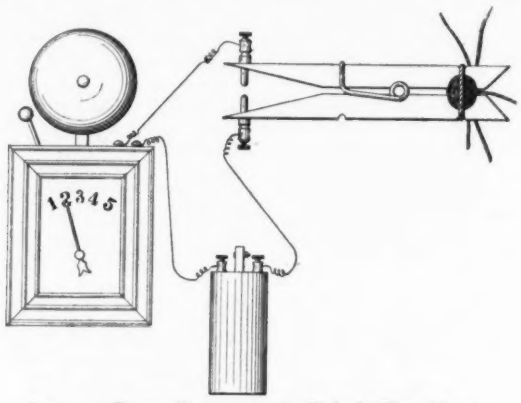
643,491. PYROXYLIN AUTOMATIC ELECTRIC FIRE ALARM; J. De Froment, of Notre Dame de Lourdes, Canada. App. filed July 26, 1899. The circuit is held in its normal condition by a cord which confines a charge of pyroxylin. This material being highly inflammable, takes fire and destroys the cord, allowing the circuit to be closed.

643,501. TROLLEY; W. G. Holmes and H. Holland, of Detroit, Mich. App. filed March 31, 1899. The trolley stand is mounted to travel along the roof of the car, so that it may always be located at the rear end of a long car.

643,506. ELECTRIC CLOCK; H. Iversen, of Corsicana, Texas. App. filed Aug. 3, 1899. Details of construction.

643,545. TELEPHONE-TELEGRAPH; A. Sinding-Larsen, Fredriksvaern, Norway. App. filed Aug. 22, 1899. (See Current News and Notes.)

643,609. SIGNALLING SYSTEM; J. J. Ruddick, of Newton, Mass. App. filed Aug. 16, 1899. A mechanical device is applied to the trolley wire and operated by the trolley wheel of a passing car to move the signals.



643,491.—Pyroxylin Automatic Electric Fire Alarm.

GERMAN PATENTS, ISSUED JAN. 31, 1900.

[In Charge of Dr. Ralph Julian Sachers, 120 Liberty Street, New York.]

106,417. STATION INDICATOR FOR ELECTRIC RAILWAYS; Max Keller, Ostrowo. App. filed Oct. 14, 1898. The station indicator, which is operated electromagnetically, indicates an open circuit. The current is produced by a dynamo on one of the axles of the car and at every stop of the train the indicator is started. Should the train be compelled to stop on the open track, a storage battery or similar device is provided which the engineer may switch in, in order to prevent the working of the indicator.

106,892. INDUCTION COILS; W. Lahmeyer & Co., Frankfurt a/M. App. filed April 30, 1898. The single coils are wound separately, and then provided with L-shaped or reversed T-shaped diaphragm disks, which take the place of the usual U-shaped coil-box.

106,155. RESISTANCE; James Burke, Berlin. App. filed Sept. 15, 1898. In a resistance box having alternately conducting and non-conducting plates, the conducting plates are connected by means of bent metal pieces, and the whole system of plates pressed together by strong screws. A very strong current is applied for a short time, which melts the metal pieces and welds the same to the resistance plates.